020165

JPRS-JST-86-033

13 NOVEMBER 1986

Japan Report

SCIENCE AND TECHNOLOGY

FBIS FOREIGN BROADCAST INFORMATION SERVICE

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL
INFORMATION SERVICE
SPRINGFIELD, VA. 22161

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS-JST-86-033

13 NOVEMBER 1986

JAPAN REPORT

SCIENCE AND TECHNOLOGY

CONTENTS

ENERGY

Petroleum Subcommittees, Structural Improvement Project Discussed
(SEKIYU SHIRYO GEPPO, Apr 86) 1

Gas Industry Plans, Policies for FY 86
(DENKI TO GASU, May 86) 5

NEW MATERIALS

Development Trend of Most Advanced Materials
(NIKKO MATERIALS, Apr 86) 27

History, Strategy of Hoya Corporation Detailed
(Tetsuo Suzuki Interview; KOGYO GIJUTSU, May 86) 38

Nagoya Fine Ceramics Fair Described
(Hajime Saito; KOGYO ZAIRYO, May 86) 45

Recent Developments in Plastics, Metals, Ceramics Reported
(NIKKO MATERIALS, May 86) 50

High-Performance Ceramic Film Discussed
(M. Ono; NIKKO MATERIALS, Jun 86) 60

NUCLEAR DEVELOPMENT

Plutonium Utilization Plan Disclosed
(GENSHIRYOKU SANGYO SHIMBUN, 5 Jun 86) 65

/12223

ENERGY

PETROLEUM SUBCOMMITTEES, STRUCTURAL IMPROVEMENT PROJECT DISCUSSED

Tokyo SEKIYU SHIRYO GEPPO in Japanese Apr 86 pp 49-53

[Article: "Joint Subcommittees of the Petroleum Council Formed--Petroleum Committee, Development Committee Form Petroleum Development Subcommittee; Petroleum Committee, Gasoline Marketing Industry Committee Form Subcommittee on Gasoline Distribution Issues"]

[Excerpt] 1. Establishment of a Joint Subcommittee (Petroleum Development Subcommittee) of Petroleum Committee and Development Committee of the Petroleum Council

Problems have arisen with the recent international oil situation which has brought about changes such as substantial declines in crude oil prices. Some development projects which have already been started are losing economic efficiency and there has been a negative tendency in the private sector's attitude in tackling new projects. Additionally, in order to improve our country's future oil development, various steps had earlier been required such as a review of the conditions for loans and investments under the loans and investments system for mining, the strengthening of the management foundation of enterprises engaged in oil development, and the collaboration between the sectors of oil refining and developing. It is necessary to examine the broad outlook of the oil situation in order to understand it and determine the course for oil development including loans and investments for mining.

Under these circumstances a Joint Subcommittee of the Petroleum and Development Committee, the Petroleum Development Subcommittee to be set up; deliberations will be made in the future centering on the following themes:

Main Themes

1) The effects lower crude oil prices will have on oil development

2) The positioning of independently developed oil under the medium- and long-term perspective on oil supply and demand

3) The way that the private development system should be (the relationship between companies operating projects and core enterprises, the advancement of the downstream sector to the development sector and the issues of collaboration between these sectors).

4) Political tasks (making the loans and investments system for mining flexible to the risks of undertakings and the way of acquiring mining fields with maneuverability).

2. Establishment of a Joint Subcommittee (Subcommittee on Gasoline Distribution Issues) of the Petroleum Committee and Gasoline Marketing Industry Committees of the Petroleum Council.

The present conditions surrounding the gasoline distribution industry are severe due to excessive competition; with chronic deficits for the past several years, the industry has developed doubts about its capability of maintaining a stable gasoline supply.

With this background, it has recently become urgent to review the effects and content of countermeasures in the gasoline distribution industry based on the Gasoline Distribution Industry Law enacted in 1976 and to consider future measures. However, these considerations should be examined from a professional and scholarly standpoint. In addition, it is necessary to examine them from a broader viewpoint including their relationship with the oil industry and the overall oil policies. Under these circumstances deliberations are to be made centering on the themes given below by setting up a subcommittee of the Petroleum Council's Petroleum and Gasoline Distribution Industry Committees.

Main Themes

1) The present status of quality assurance issues and tasks

2) The present status of gasoline distribution, market order, and tasks

3) The structural improvement of the gasoline distribution industry

4) Proper deregulation of the gasoline distribution industry

Approval of Structural Improvement Project Drawn Up in Accordance With Smaller Enterprise Modernization Law

On receiving a report from Small and Medium Enterprise Modernization Council on the structural improvement project for the oil products distribution industry, MITI approved it as stated in its draft on 31 March. (Notification date: 9 April)

The oil products distribution industry was designated as a special industry in November 1983 in accordance with the Smaller Enterprise Modernization Law; the modernization plan was drawn up in June 1985. The National Federation of Oil Products Distributors' Associations began the formation of a structural improvement project and completed a draft with the aim to concretely implement the modernization of the industry in accordance with the modernization plan. The draft project was submitted on 25 March to MITI for approval and subsequently a meeting of the council was held to deliberate it.

The structural improvement project is a concrete program to achieve three targets shown in the modernization plan, which includes the establishment of an effective sales system and a stable management foundation and assurance of product quality. This proejct is centered around three points; i.e., the diversification of business, information-networking, and regrouping of enterprises. It includes the improvement of transactions such as ensuring the following of fair competition rules and indicates the goal to achieve it by fiscal 1989. The project which has been approved this time, consists of two programs, one being an overall program covering the period until fiscal 1989 and the other covering fiscal 1986. The funds required until the final completion year are estimated to total ¥55 billion.

List of the Petroleum Council's Petroleum Committee Members

April 1986

Name	Official Title
Chairman Jiro Enjogi	Advisor to Nihon Keizai Shinbun
Shingo Ariyoshi	President, Japan Coal Association
Hiroshi Anzai	President, Japan Gas Association (corporation)
Toyoaki Ikuta	Chief director, Japan Energy Economics Research Institute (foundation)
Akisuke Idemitsu	President, Idemitsu Kosan K.K.
Hidezo Inaba	Chief director, Research Institute for Industry
Yukio Ouchi	Commentator, Japan Broadcasting Corporation
Shin Ono	Chairman, Nippon Yusen K.K.
Torao Okumura	Vice president, Japan Steel Federation (corporation)
Kinichi Katsube	Vice president, Japan Federation of Livelihood Cooperative Association
Minoru Kaya	Chairman, Kyodo Oil Co.
Yasunobu Kishimoto	President, Petrochemical Industrial Association
Mitsuo Kono	Vice-chairman, Editorial Committee, Yomiuri Shinbun
Masao Sakisaka	President, International Energy Policy Forum
Yoshio Sasano	President, National Federation of Oil Products Distributors' Associations
Tsuyoshi Suenaga	President, Oil Stockpile Council
Gaku Taguchi	Chairman, Central Executive Committee, National Council of Oil Industry Labor Unions
Yasuoki Tateuchi	President, Petroleum Association of Japan
Satoko Tanaka	Secretary-general, Federation of Tokyo Metropolitan Area Women's Organizations
Mitsugu Nakamura	Professor of Economics at Tokyo University
Yoshiro Nakayama	President, Cosmo Oil Co.
Tokio Nagayama	Chairman, Showa Shell Sekiyo K.K.
Yasubumi Niikura	President, National Passenger Car Federation (corporation)
Kiyoshi Nozawa	Vice president, Federation of Electric Power Industry
Nihachiro Hanamura	Vice president, Federation of Economic Organizations
Junnosuke Hidaka	President, Federation of Oil Drilling Industry

Name	Official Title
Masao Fukui	Counselor, Japan LP Gas Institute
Akira Matsuyama	Chairman, Toa Nenryo Kogyo K.K.
Kyuichi Miyahara	President, National Federation of Fisheries Cooperative Associations
Hiroshi Murakami	Member of Editorial Committee, Kyodo News Agency
Yoshihiko Morozumi	Chairman, Japan Shurunberg K.K.
Keizaburo Yamada	Vice-chairman, Mitsubishi Corporation
Toshinobu Wada	President, Petroleum Corporation

20110/8918
CSO: 430/2607

ENERGY

GAS INDUSTRY PLANS, POLICIES FOR FY 86

Tokyo DENKI TO GASU in Japanese May 86 pp 2-10

[Article by Gas Industry Division, Agency of Natural Resources and Energy, MITI: "1986 Policy for Gas Industry"]

[Text] I. Actual State of City Gas Industry

The Japanese city gas industry consists of 248 firms at present. As these firms have developed independently in their cities, there are large differences in the business scales as well as in materials and heat quantities of gas supplied. The differences in forms of business are especially notable between the three major firms (Tokyo Gas Co., Ltd., Osaka Gas Co., Ltd., and Toho Gas Co., Ltd.) and other firms.

Namely, among the 248 firms with some 18.36 million consumers and a supply of 11.4 billion cubic meters (converted as 10,000 kilocalories per cubic meter) (all figures as of 1984), the three major firms have about 12.3 million consumers and 8.5-billion-cubic-meter sales, which corresponds to a high 75 percent share in the industry.

The heat quantity of gas supplied, which varies greatly depending on the firm, covers a wide range from 3,600 to 24,000 kilocalories per cubic meter, and the combustibility is classified into 14 categories. In addition, the materials used for the production of gas are also diversified. The first occasion of changing the materials of city gas was the energy revolution in late fifties to the early half of the sixties, in which coal materials were replaced by petroleum materials, such as crude oil and naphtha. Later, after the introduction of LNG in 1969 and the application of LPG during the first oil crisis in 1973, the present material composition is 56.8 percent LNG, 19.3 percent LPG, 9.7 percent coal, and 6.6 percent natural gas produced in Japan. This drastic change is due mainly to the development of the share of LNG in materials (75 percent of all material as of 1984) in the three major firms which sell more than 70 percent of Japan's total gas supply. (See Figure 1)

Meanwhile, the share of LNG in the materials is only 1.2 percent with firms other than the three major firms.

The concrete policy for the gas industry should be developed in consideration of the various differences that lie between the three major firms and others.

The most important policies for fiscal year 1986 are as follows.

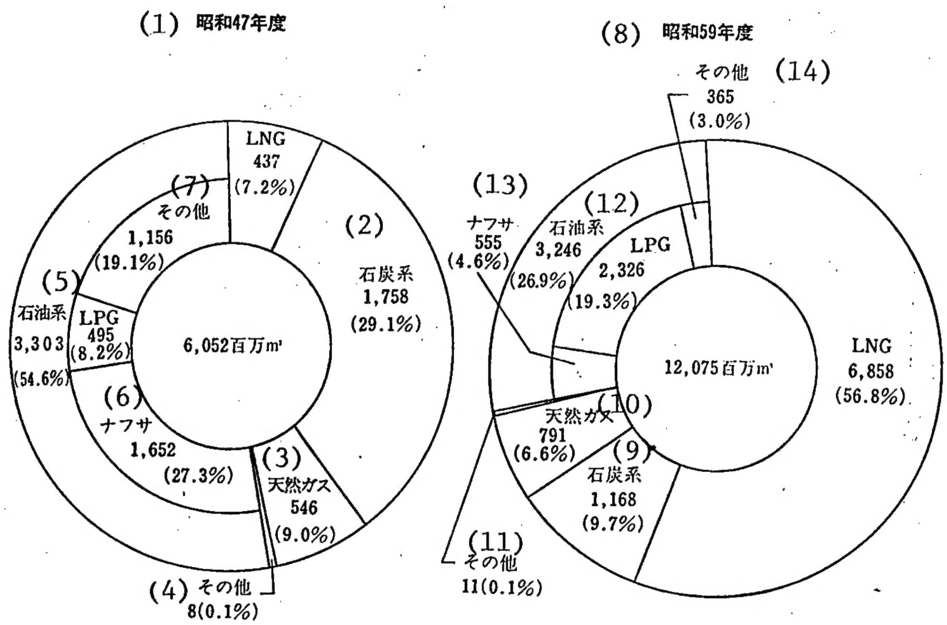


Figure 1 Change of Composition of Gas Materials
(Unit: million cubic meters, 10,000 kilocalories)

Key:

1. 1972
2. Coal materials
3. Natural gas
4. Others
5. Petroleum materials
6. Naphtha
7. Others
8. 1984
9. Coal materials
10. Natural
11. Others
12. Petroleum materials
13. Naphtha
14. Others

II. Promotion of LNG Use for Local City Gas Industry

1. Promotion of use of LNG through Introduction of Natural Gas Promotion Center

As is commonly known, LNG, together with coal and nuclear power, is classified as one of the representative alternative energy sources for petroleum because of the high stability of its supply. Also, from the viewpoint of the gas industry, the introduction of LNG has merit in both cost and safety. The cost advantage includes the reduction of installation and labor costs thanks to the simple gasification process, high efficiency of energy thanks to small loss in gasification, and high efficiency of utilization of supply facilities, such as gas pipes and containers, thanks to the high heat quantity. LNG features high safety even in case of gas leakage. It does not explode because LNG diffuses easily in the air having a smaller specific gravity than air, and it does not cause poisoning because it does not contain carbon monoxide.

However, LNG at present has been introduced in only 20 firms--the three major firms and their subsidiaries.

The introduction of LNG is not advanced in other firms because of insufficiencies in 1) funds for initial expenses, including equipment investment and heat quantity change works, and 2) technical abilities.

To support the introduction of LNG in local city gas firms by solving the above problems, MITI will continue to develop the required policies as started in 1985 through the Introduction of Natural Gas Promotion Center (established on 25 August 1985), which is a foundation specializing in promoting the introduction of LNG in local city gas firms. (See Table 1.)

The enterprises of the center include: 1) demand and supply policy for the stable supply of natural gas; 2) subsidy of interest for funds for heat quantity change borrowed from financial institutions; 3) training of personnel in heat quantity change operations; and 4) technical guidance for on-the-spot supervision of heat-quantity change operations performed by local gas industry. In order to promote those enterprises, the center will provide more subsidies than 1985 for their budgets. (See Table 1.)

As in 1985, the center is also entrusted with research on the technical and financial possibilities of the common use of natural gas transportation facilities in order to reduce the equipment investment cost required when local city gas firms adopt LNG.

2. Special-interest loan for equipment investment

The introduction of LNG in local city gas firms requires equipment investments for LNG shipping and receiving facilities, transportation facilities, and heat-quantity change operations. These investments will be subject to special loans through the Japan Development Bank and the Hokkaido-Tohoku Development Corporation at a loan ratio of 40 percent and an interest rate of 5 percent. A similar loan is also made available from the Small Business Finance Corporation.

To make these special loans possible, the Japan Development Bank is supplied with a non-interest-bearing loan from the Oil-Coal Special Account, and the Hokkaido-Tohoku Development Corporation and the Small Business Finance Corporation are supplied with interest subsidies.

Treasury loans and investments for introduction of LNG in local city gas industry:

1. Loan from Japan Development Bank:

Within the ¥18-billion limit on loans for the promotion of alternative energy source utilization (within the ¥18.5-billion limit on loans for the promotion of alternative energy source utilization).

Interest 5 percent, loan ratio 40 percent.

2. Loan from Hokkaido-Tohoku Development Corp.:

Within the ¥40.5-billion limit on special-interest loans (within the ¥40.5-billion limit on special-interest loans).

Interest 7.0 percent, loan ratio 40 percent.

3. Loan from Small Business Finance Corp.:

Within the ¥102-billion limit on energy policy loans (within the ¥10-billion limit on loans for promotion of alternative energy source utilization).

Interest 5 percent.

Budgets:

1. Loan for Japan Development Bank:

Oil-Coal S/A [special account] (Alternative Energy Source), within ¥4.77 billion (within ¥5.55 billion).

2. Interest subsidy for specified equipment for introduction of LNG in local city gas industry (for Hokkaido-Tohoku Development Corp.):

Oil-coal S/A (Alternative Energy Source), ¥5.1 million (¥1.7 million).

3. Interest subsidy for specified equipment for alternative energy sources (for Small Business Finance Corp.):

Oil-Coal S/A (Alternative Energy Source), within ¥470 million (within ¥350 million).

III. Promotion of Efficient Gas Supply and Level Gas Demand

In parallel with the above-mentioned measures in the material level, the use of LNG will also be promoted from the standpoint of demand.

The gas demand varies each year between the peak in the winter and off-peak in the summer. To eliminate the poor equipment efficiency caused by this and to expand the use of LNG, LNG gas will first be developed for industrial purposes which have level demand throughout the year. The demand in the summer off-peak season will be increased by spreading the use of gas cooler equipment.

This policy will be supported by continuing the measures we have already started; i.e., the special tariff systems for industrial LNG and gas cooling systems, loans from the Japan Development Bank or Small Business Finance Corporation, tax exemption for gas used in gas cooling systems, and reduction of real estate tax for gas cooling system.

IV. Reform of Taxation System Related to Gas Industry

The taxation system concerning the gas industry was subject to a notable reform favorable for the advance of our policy. The main contents of the reform are as follows.

1. Provision for special repairs

[Boxed item: The repair expenses required for overhaul inspections of spherical gas containers owned by ordinary gas enterprises are added as an object of the provision for special expenses. (See Table 4.)]

Gas containers are subject to compulsory periodic inspection once a year. It is just an inspection from the outside, and no internal inspection that requires breathing inside gas is required by regulations. Meanwhile, for the maintenance and improvement of the safety of spherical gas containers that are subject to high internal pressure, it is necessary to have as perfect internal inspections as possible.

However, the expense of overhaul inspection is a heavy burden for small firms because it costs ¥30 to ¥50 million per container. In addition, the expenses would distort the profit and loss account of the firm if all of them must be charged as expenses of the term in which the inspection is made.

To perform overhaul inspections deliberately and steadily, it is indispensable to have proper accounting and not to treat the expenses of an overhaul inspection as temporary expenses, but to make a reserve for them in order to optimize the allocation to several terms. So that the reserve is included in the loss in tax calculation, it is also necessary to make it an object of provision for special repairs.

It is for the above reason that the repair expenses spent in overhaul inspections of spherical gas containers are added as an object of the provision for special expenses.

The provision system for special expenses, defined in the Corporation Tax Act, was founded by the Shoup [Recommendations] Tax System in 1950. Except for the addition of the blast furnace and air-heating furnace for pig-iron manufacturing and the continuous blast furnace for glass manufacturing in 1951, no objects of the provision have been added for 35 years until the present reform, which was really exceptional.

It has been determined that the Corporation Tax Act will be applied from the fiscal year ending 1 April 1986 or after. The concrete standards concerning the calculation method of the reserve limit, the range of expenses included, etc., will be determined by the amendment of the Corporation Tax Act Enforcement Order and by MITI communications. Preparations are almost complete under cooperation between MITI and the Ministry of Finance.

2. Taxation system for promotion of equipment investment for enhancement of energy foundation

The "taxation system for promotion of equipment investment to enhance energy foundation" was created to improve the energy demand and supply structure. The new system legalizes a 7-percent tax exemption or a 30-percent special depreciation of acquisition cost for equipment necessary for this purpose and, with equipment related to the gas industry, it is applied to the items listed below. (See Table 4.)

Accompanying the creation of this system, the "investment promotion taxation system for enhancement of energy utilization" was abrogated on 31 March 1986.

List of equipment related to gas industry

--High-performance absorption water cooler-heaters (those with a refrigerating capacity of 30,000 kilocalories per hour or more, or number-controlled type equipment)

--Steam supply and power generating plant equipment

--Gas cooling equipment

--Gas-operated steam generators

--Gas-operated industrial furnaces

--Multi-type LNG storage equipment

--High-efficiency radiant heaters (for small and medium businesses)

--Thermal temperature controlling gas carburetion dehydrator equipment (for small and medium businesses)

V. Promotion of Gas Safety Measures

Safety is the fundamental theme for the gas industry, required at all times regardless of age. The safety measures must be perfect in any stage from production to consumption of gas.

The safety measures for city gas can be classified basically into those for gas workpieces owned by gas firms and those for gas consumption equipment owned by the users. In either case, the basic subject is how to prevent gas leakages.

1. Safety measures for gas users

In September 1984 the "Enforcement Regulations for the Gas Industry Act," "MITI Ordinance for Determination of Technical Standards Required for Gas Works," and MITI notifications based on the above were subject to amendment in accordance with the report ("Future Safety Measures for City Gas Users") issued by the "Investigation Commission for the Safety of Gas-Consuming Equipment," a private consultative organ, to the director general of the Agency of Natural Resources and Energy, MITI. The points of these amendments were as follows:

1. For effective enhancement of preventive measures against gas accidents, the users are classified according to the buildings which house them. Measures are taken for each building to meet the user characteristics, such as gas consumption styles and environments.

2. For household users, sufficient measures are applied to their equipment (by installation of fuse cocks, incorporation of dieout-preventing safety mechanisms in heaters, etc.) to make safety less dependent on the care of the users and to make intentional gas leakage difficult. The target safety level is the reduction of the number of accidents to one-tenth of the present statistics.

3. For industrial users, large-scale enhanced safety measures are taken to prevent accidents. In addition to similar measures for household equipment, the measures for equipment include the installation of gas-leakage alarms and gas-blast circuit breakers for each building, and those for safety administration include the appointment of a person in charge of contacts at each user.

As well as the ministerial ordinances, also under examination are partial modifications of "Enforcement Ordinance for Gas Industry Act" (expansion of gas-operated items to which the act is applied), "MITI Ordinance for Approval of Gas-Operated Items" (establishment of technical standards following the expansion of definition, reconsideration of current standards), and "Enforcement Ordinance for the Act for Supervision of Installation Works of Specific Gas-Consuming Equipment" (expansion of gas-consuming equipment to which the act is applied).

2. Prevention measures against corrosion of underground piping of small gas-supply systems

The small gas-supply industry includes 1,663 firms with 1.41 million supply points (users) and a total sales of 138 million cubic meters at 24,000 kilocalories (as of the end of 1984). The industry consists mainly of small firms, many of whom sell LPG, kerosene, etc., as a side business. With relatively low technical levels, their piping design, installation, maintenance, and administration are generally insufficient, and with some firms safety consciousness is also low.

To prevent accidents due to this condition, the following research is conducted for underground piping of small gas-supply systems in fiscal year 1986 in continuity with 1985.

1. The relationship between the corrosion of various types of gas pipes or degradation of paint or coating and the phenomena which may promote the corrosion, such as the characteristics of soil, should be clarified. At the same time, research and development on pipe corrosion diagnosis techniques without excavation, corrosion-prevention techniques, and maintenance and administration techniques will also be conducted.

2. On the other hand, as investigations in item 1 necessitate a considerable period before the results are obtained, gas leakage will be checked by enhanced inspections for the time being.

Budget:

Development of safety administration technology for underground gas piping of small gas-supply systems.

Oil-Coal S/A (Oil), ¥142 million (¥106 million).

3. Administration of LNG (liquefied natural gas) Storage Tanks

For longer service life and lower maintenance cost of LNG storage tanks, research will be conducted to develop a system that allows making the LNG storage tank administration system more rationalized.

The inside of gas tanks have been checked by overhaul inspections. However, the overhaul inspection cannot always be applied uniformly to all LNG tanks due to the difficulties caused by following factors.

1. Temperature changes, etc., exert bad influences on the structural elements.

2. An overhaul inspection takes a long period of time because of the necessity of heat-up operations, etc. (Period: about half a year)

3. The cost of an overhaul inspection is high because it should be carried out in a nitrogen atmosphere. (Cost: hundreds of millions of yen per tank)

4. The safety of overhaul inspection in air atmosphere cannot be guaranteed by present technology. (In fact, a serious accident, killing or injuring many people, occurred during the servicing of an LNG underground tank in the United States 10 years ago.)

Therefore, it has become an immediate task to start research into the hardware and software of a rational LNG tank maintenance method without direct overhaul. It may be based on the advance of sensor technology made possible by recent technological innovations.

Research into a more effective and rationalized storage tank administration system will be started in 1986, and the basic idea and programs will also be studied.

Budget:

Research into LNG storage tank administration system.

Oil-Coal S/A (alternative energy source), ¥40 million (0).

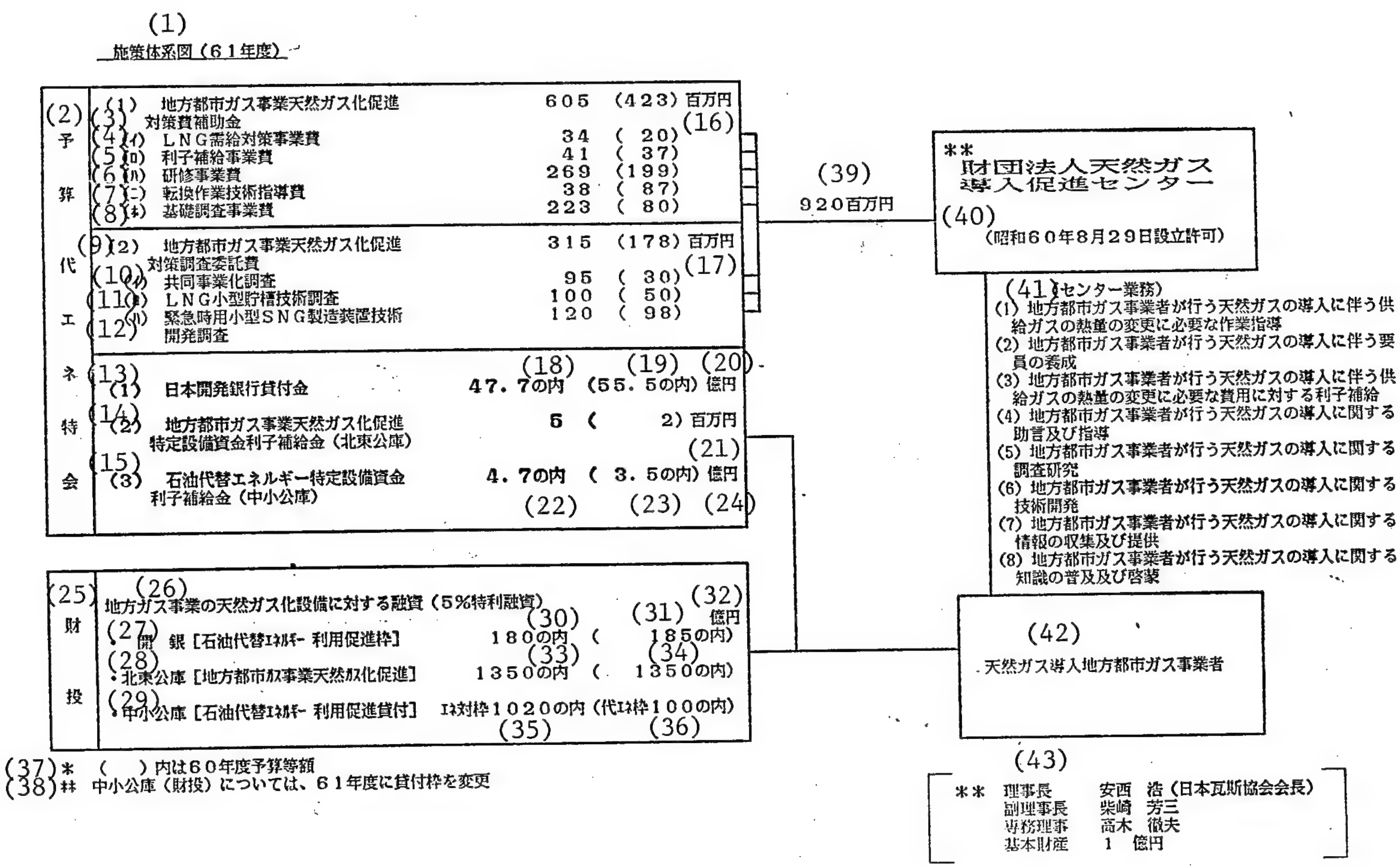
For the cogeneration system, "research into natural gas effective utilization system development" started in 1985 will be continued in 1986 for the development of an optimum system that can meet the structure of energy demand from various users.

Budget:

Research into natural gas effective utilization system development.

Oil-Coal S/A (alternative energy source), ¥50 million (¥28 million).

Table 1. Measures for Promotion of LNG Use in Local City Gas Industry



[Key on following page]

Key:

1. Policy System (1986)
2. Budget: Alternative Energy Source S/A
3. (1) Subsidies for expenses in promotion of LNG in local city gas industry
4. a. Expenses for LNG demand and supply control
5. b. Expenses for interest subsidy
6. c. Expenses for training
7. d. Expenses for technical guidance in changeover operation
8. e. Expenses for basic investigations
9. (2) Commission expenses for investigations into measures for promotion of LNG in local city gas industry
10. a. Investigation in joint enterprise conditions
11. b. Investigation in small LNG storage tank technologies
12. c. Investigation in development of small-sized SNG manufacturing equipment technology for use in emergency
13. (1) Loan for Japan Development Bank
14. (2) Interest subsidy for specified equipment for introduction of LNG in local city gas industry (Hokkaido-Tohoku Development Corp.)
15. (3) Interest subsidy for specified equipment for alternative energy sources (Small Business Finance Corp.)
16. ¥million
17. ¥million
18. Within 4.77
19. (within 5.55)
20. ¥billion
21. ¥million
22. Within 470
23. (within 350)
24. ¥million
25. Treasury loans and investments
26. Loans for LNG equipment in local city gas industry (at 5 percent special interest)
27. - Japan Development Bank
    (Limit of loans for alternative energy source utilization promotion)
28. - Hokkaido-Tohoku Development Corp.
    (Promotion of LNG use in local city gas industry)
29. - Small Business Finance Corp.
    (Loans for alternative energy source utilization promotion)
30. within 18.0
31. (within 18.5)
32. ¥billion
33. within 135.0
34. (within 135.0)
35. as energy policy plan, within 1020
36. (as alternative energy source loan, within 10)

37. * Figures in ( ) are of the 1985 budget.
38. ** With the Small Business Finance Corp. (treasury loans and investments), the loan limit was transferred in 1986.
39. ¥920 million
40. ** Foundation
(Introduction of Natural Gas Promotion Center)
(established on 25 August 1985)
41. Businesses of the center:
   (1) Guidance required for heat-quantity change operations of supplied gas accompanying the introduction of LNG in local city gas firms
   (2) Training of personnel required for the introduction of LNG in local city gas firms
   (3) Interest subsidies for expenses required for heat-quantity change operations of supplied gas accompanying the introduction of LNG in local city gas firms
   (4) Assistance and guidance for the introduction of LNG in local city gas firms
   (5) Investigation and research on the introduction of LNG in local city gas firms
   (6) Development of technologies for the introduction of LNG in local city gas firms
   (7) Collection and provision of information on the introduction of LNG in local city gas firms
   (8) Popularization or education of knowledge on the introduction of LNG in local city gas firms
42. Local city gas firms introducing LNG
43. **

Chief director	Hiroshi Anzai (President of Japan Gas Association)
Deputy chief director	(Hozo Shibazaki)
Representative director	Tetsuo Takagi
Endowment	¥100 million

Table 2. Subsidies and Investigation Commission Expenses for Policy of Promotion of Introduction of LNG in Local City Gas Industry (Unit: thousand)

(15)年度 項目 (1)		(16) 60 予算額	(17) 61 予定額	(18) 比較増▲減額	(19) 事業の概要
(2) 補助金	(3) (1) 需給対策事業	20, 252	34, 098	13, 846	(20) ＬＮＧの需給動向を常時把握することにより、地方都市ガス事業者への天然ガスの安定供給を確保する。
	(4) (2) 利子補給事業	36, 460	40, 730	4, 270	(21) 地方都市ガス事業者の熱量変更作業に係る資金コストの軽減を図るため、金融機関から調達する熱量変更に係る資金に対し、センターを通じて利子補給を行う。
	(5) (3) 研修事業	199, 366	268, 960	69, 594	(22) 地方都市ガス事業者の熱量変更作業要員に対して、熱量変更に必要な有形・無形の技術・ノウハウを修得させるための研修をセンターにおいて行う。
	(6) (4) 転換作業技術指導事業	86, 603	37, 585	▲49, 018	(23) 地方都市ガス事業者の熱量変更作業現場で、熱量変更作業員を指導・監督する者をセンターから派遣する。
	(7) (5) 基礎調査事業	80, 100	223, 235	143, 135	(24) 地方都市ガス事業者の熱量変更に必要な器具調整方法の決定、地区分割設計等の準備作業についてセンターにおいて標準化及び指導員の派遣を行う。
	(8) 計	422, 781	604, 608	181, 827	
(9) 委託費	(10) (1) 共同事業化調査	30, 428	94, 645	64, 217	(25) 地方都市ガス事業者の天然ガス導入コストの軽減を図るため (1) 天然ガス輸送設備等の共同利用の可能性について、技術・資金面等の調査 (2) 導入規模に応じた小型のＬＮＧ貯槽の標準化を図るため、その耐震性等の調査 (3) 圧力が低くかつ小型のＳＮＧ（代替天然ガス）製造装置の開発を行うため、触媒等についての調査 を行う。
	(11) (2) ＬＮＧ小型貯槽技術調査	49, 584	100, 550	50, 966	
	(12) (3) 緊急時用小型ＳＮＧ製造装置技術開発調査	97, 679	120, 000	22, 321	
	(13) 計	177, 691	315, 195	137, 504	
(14) 合計		600, 472	919, 803	319, 331	

[Key on following page]

[Key to Table 2]

Key:

1. Item
2. Subsidies
3. (1) LNG demand and supply control
4. (2) Interest subsidy
5. (3) Training
6. (4) Technical guidance for changeover operations
7. (5) Basic investigations
8. Subtotal
9. Commission expenses
10. (1) Investigation in joint enterprise conditions
11. (2) Investigation in small LNG storage tank technologies
12. (3) Investigation in development of small-sized LNG manufacturing equipment technology for use in emergency
13. Subtotal
14. Total
15. Fiscal year
16. 1985 budget
17. Estimated 1986 budget
18. Relative increase : Decrease
19. Outline of operations
20. Grasping permanently the general trend of LNG demand and supply in order to assure a stable LNG supply for local city gas firms.
21. To supply, through the Introduction of Natural Gas Promotion Center, the interest which local city gas firms should pay for their heat-quantity change operations funds borrowed from financial institutions in order to reduce the burden of cost for these operations.
22. To perform training at the center of heat-quantity change operators from local city gas firms in order to teach them material and non-material techniques and know-how required for the operations.
23. To dispatch supervisors from the center to give guidance to heat-change operators on the spot of heat-quantity change operations by local city gas firms.
24. To determine the standards of the appliance adjustment methods and sub-area-splitting design, etc., required in heat-quantity change operations of local city gas firms at the center, and to dispatch instructors for them.
25. To perform the following research in order to reduce the heat-quantity change costs of local city gas firms:
    (1) Investigations in technology and funds that can make common-use of LNG transport facilities, etc., possible.
    (2) Investigations in earthquake-resistance, etc., for the standardization of small LNG storage tanks with diverse sizes depending on the scale of LNG introduction.
    (3) Investigation in catalyzers, etc., for the development of low-pressure, compact SNG (substitute natural gas) production equipment.

Table 3. List of 1986 Treasury Loans & Investments for Gas Industry (As of Feb 28)

(1) 金融機関	(8) 項	目	(29) 対象事業者	(50) 対象設備	(71) 61年度計画額	(87) 融資比率	(92) 金利	(105) 備考
(2) I 日本開発銀行	(9) 資源エネルギー	ガ (10) ス	3大都市圏で60万戸以上の需要家に都市ガス供給する一般ガス事業者(東京, 大阪, 東邦の3社) (30)	1. 特定ガス導管(保安通信設備・土地含む) (51) 2. LNG設備(受入, 貯蔵, 気化, 配管, 防液堤) 3. SNG設備(発生設備, 附属設備) 4. 地区分割用導管(しゃ断弁以外の附属設備含む) 5. しゃ断弁(附帯工事を含む)	億円 (72) 155 (73)	40%	当初3年 6.30% 4年目以降 6.75% (93) 6.75% 6.75% 通利 通利	
		(11) 石油代替エネルギー利用促進	一般ガス事業者及び需要家 (31) (「3」については, 一般ガス事業者(大手三社を除く)及び一般ガス事業者に天然ガス(LNGを含む)を供給する者)	1. 産業用LNG専用導管等(※産業用LNG専用基地設備を除く) (52) 2. ガス冷房設備(非石油系都市ガスを利用するものに限る) 3. 地方都市ガス事業天然ガス化設備(出荷・受入, 熱量変更設備)	(74) 枠で 180	40%	5.00%	64年度時限 (106) 61年度時限 6[illegible]年度時限
		省資源・省エネルギー (12)	一般ガス事業者及び需要家 (32)	省エネルギー型業務用設備(改良型二重効用吸収式冷温水機, ガスエンジンヒートポンプ等) (53)	枠で (75) [illegible]0	40%	6.75%	
	(13) 国民生活改善	(14) 公害防止 (15)	一般ガス事業者(40.6.1以後に設立されたものに限る) (33) (40.5.31以前の事業者は公害防止事業団の融資) (34)	1. ばい煙防止, 汚水処理等 2. 廃棄物処理 3. 排煙脱硫 4. 排煙脱硝 (54)	—	50%	当初3年 6.75% 4年目以降 6.80% (94)	
		無公害工程転換	公害防止指定区域の都市ガス需要家	従来の燃料に変えて都市ガスを利用する設備 (55)	—	50%	同 (95) 上	
		工場[illegible]設備 (16)	一般ガス事業者 (35)	緑地その他環境施設用土地の取得及び造成 (56)	—	(88) 50%(土地 30%)	6.80%	
			一般ガス事業者及びリース業者 (36)	都市ガス漏れ警報設備(リース事業) (57)		40%	通 (96) 利	
	都市開発(共同溝) (17)		一般ガス事業者 (37)	共同溝負担金及び附帯工事費(共同溝の整備特別法による共同溝に限る) (58)	枠で (76) 780	40%	通 (97) 利	
	地域開発・ガス (18)		北東公庫, 開銀(その他枠・ガス枠)の対象とならない一般ガス事業者 (38)	1. 供給圧力改善設備(本支管, 圧送機, ホルダー) 2. 地震対策等ガス保安設備 3. 地方ガス事業特定導管 (※口径150mm以上, 圧力2.9kg以上) (59) 4. その他(製造設備, 供給設備, 業務設備)	枠で 1,200 (77)	50% 50% 50% 40%	6.80% 当初3年 6.5% 4年目以降 6.8% 6.75% (98) 通利	
	その他・都市ガス (19)		東京, 名古屋, 大阪周辺のガス事業者で中小公庫から融資を受けられない者(東京, 大阪, 東邦3社除く) (対象設備の2については共同出資法人を含む) (39)	1. 供給圧力改善設備 2. 広域供給近代化設備(導管ホルダー製造設備, 附属設備及び建物, 土地) 3. 地震対策等ガス保安設備 4. 地方ガス事業特定導管 (60) 5. その他	(78) 枠で 310	50% 40% 50% 50% 40%	6.8% 通利 (99) 当初3年 6.5% 4年目以降 6.8% 6.75% 通利	
(3) II 北海道・東北開発公庫	ガス (20)		北海道, 東北(新潟を含む)地区の一般ガス事業者 (40)	1. 供給圧力改善設備 2. 地震対策等ガス保安設備 3. 地方ガス事業特定導管 (61) 4. その他	(79) 枠で 1,350	北海道地区 50% 東北地区 40% (89)	(100) 6.8% 当初3年 6.5% 4年目以降 6.8% 6.75% 通利	
	地方都市ガス事業天然ガス化促進 (21)		同上及び一般ガス事業者に天然ガス(LNGを含む)を供給する者 (41)	地方都市ガス事業天然ガス化設備(出荷・受入, 熱量変更設備) (62)		40%	5.00%	64年度時限 (107)
(4) III 中小企業金融公庫	中小ガス事業近代化貸付 (22)		一般ガス事業者 (42)	1. 供給圧力改善設備等(本支管, 圧送機, ホルダー, 地方ガス事業輸送導管) (63) 2. その他	(80) 枠で 1,020	貸付限度額 4億円 うち特利分 2.7億円 (90)	6.85% (101) 通利	
	産業安全衛生施設等貸付 (23)		同上及び簡易ガス事業者 (43)	地震対策設備 (64)	枠で (81) [illegible]00		当初3年 6.5% (102) 4年目以降 6.8%	
	省エネルギー貸付 (24)		中小企業者等 (44)	改良型二重効用吸収式冷温水機等 (65)	枠で (82) [illegible]020		6.8%	
	石油代替エネルギー利用促進貸付 (25)		同上 (45)	石油代替エネルギー使用及び供給設備 (受入・貯蔵設備, 搬送設備, 燃焼設備, 冷房設備) (地方都市ガス事業天然ガス化設備を含む) (66)	枠で 1,020 (83)	貸付限度額 4億円 (但し, 代エネ 3.5億円) うち特利分 2.7億円	代エネ割合 40% …… 5.00% 代エネ割合 (103) 2[illegible]% 当初3年 6.3% 4年目以降 6.8%	
	液化石油ガス転換促進貸付制度 (26)		灯油等石油中間留分を燃料とする設備から, 液化石油ガスを燃料とする設備に転換する中小企業者等 (46)	1. 受入貯蔵設備 2. 搬送設備 3. 燃焼設備 (67) 4. 発電設備	枠で 1,020 (84)	(91)	6.8%	
(5) IV 沖縄振興開発金融公庫	産業開発資金 (27)		沖縄ガス (47)	ガス製造設備, 供給設備及びそれらの附属設備(土地, 建物を含む) (68)	枠で (85) [illegible]00	80%	6.3%	
(6) V 地方債			公営ガス事業者 (48)	ガス事業設備 (69)	(86) 75	—	政府資金 6.3% 公営公庫 6.4% (104)	
(7) VI 中小企業事業団	安全衛生設備リース事業 (28)		ガス事業者の営む協同組合等 (49)	供給圧力改善設備等 (70)		70%(65%)	2.70%	

(103) (注) 通利は6.9%である。

[Key on following page]

Key:

1. Financial institution
2. I. Japan Development Bank
3. II. Hokkaido-Tohoku Development Corp.
4. III. Small Business Finance Corp.
5. IV. Okinawa Development Finance Corp.
6. V. Municipal bonds
7. VI. Small Business Corp.
8. Item
9. Natural resources and energy
10. Gas
11. Alternative energy source utilization promotion
12. Resource saving, energy saving
13. National life improvement
14. Pollution prevention
15. Changeover to no-pollution processes
16. Plant environment arrangement
17. Urban development (underground multipurpose duct)
18. Local development - gas
19. Others - city gas
20. Gas
21. Promotion of LNG use in local city gas industry
22. Loans for transformation of small and medium gas industry
23. Loans for industrial safety and sanitary facilities
24. Loans for energy saving
25. Loans for alternative energy source utilization
26. Loans for promotion of changeover to LPG
27. Industrial development fund
28. Leases of safety and sanitary facilities
29. Object enterprises
30. General gas enterprises supplying city gas to 600,000 or more users in the three urban areas (i.e., Tokyo Gas, Osaka Gas, and Toho Gas)
31. General gas enterprises and users (Object equipment item 3 applies to general gas enterprises, except three major firms, and to suppliers of natural gas, including LNG, to general gas enterprises.)
32. General gas enterprises and users
33. General gas enterprises (those established on or after 1 June 1965) (Enterprises established on or before 31 May 1965 are to be financed by the Environmental Pollution Control Service Corp.)
34. City gas users in areas under environmental pollution control
35. General gas enterprises
36. General gas enterprises and lease businesses
37. General gas enterprises
38. General gas enterprises not subject to loans from Hokkaido-Tohoku Development Corp. or Japan Development Bank (frame of Others or Gas)
39. Gas enterprises near Tokyo, Nagoya, and Osaka which cannot be financed by Small Business Corp. (except three major firms: Tokyo Gas, Osaka Gas, and Toho Gas)
    (Object equipment item 2 applies also to joint capital investor corporations.)

40. General gas enterprises in Hokkaido and Tohoku (including Niigata)
41. General gas enterprises in Hokkaido and Tohoku, and suppliers of natural gas (including LNG) to these general gas enterprises
42. General gas enterprises
43. General gas enterprises and small gas-supply firms
44. Small and medium gas enterprises
45. Same as above
46. Small and medium enterprises which change from equipment using petroleum middle cut, such as kerosene, as fuel to equipment using LPG as fuel
47. Okinawa Gas Co., Ltd.
48. Public gas enterprises
49. Cooperative associations, etc., run by gas enterprises
50. Object equipment
51. 1. Specified gas pipes (including communication equipment for maintenance and land)
    2. LNG equipment (acceptance, storage, gasification, piping, dike)
    3. SNG equipment (generator, ancillary facilities)
    4. Sub-area-splitting pipes (including ancillary facilities other than cutoff valves)
    5. Cutoff valves (including appurtenant works)
52. 1. Industrial LNG exclusive pipes, etc. (* excluding industrial LNG exclusive base installations)
    2. Gas cooling equipment (using non-petroleum city gas only)
    3. Equipment used for introduction of LNG in local gas enterprises (shipping, acceptance, heat-quantity change equipment)
53. Energy-saving type industrial equipment (improved double-effect absorption water cooler/heater, gas-engine heat pump, etc.)
54. 1. Smoke and soot prevention equipment, waste water disposal facility, etc.
    2. Wastes treatment equipment
    3. Flue-gas desulfurizer
    4. Exhaust-gas denitrizer
55. Equipment using city gas in place of conventional fuel
56. Acquaintance and arrangement of land used for environmental facility such as green district
57. City gas leak alarm equipment (leases)
58. Burden charge for underground multipurpose ducts and expenses for appurtenant works (only for underground multipurpose ducts as defined in the special law for arrangement of multipurpose ducts)
59. 1. Supply pressure improvement equipment (main and auxiliary pipes, gas compressors, containers)
    2. Gas safety equipment against earthquake, etc.
    3. Specified pipes for local gas enterprises (* diameter 150 mm or more, pressure 2.9 kg/cm^2 or more)
    4. Others (production equipment, supply equipment, operation equipment)

60. 1. Supply pressure improvement equipment
    2. Wide-area supply transformation equipment (pipe support production equipment, ancillary equipment, buildings, land)
    3. Gas safety equipment against earthquake, etc.
    4. Specified pipes for local gas enterprises
    5. Others
61. 1. Supply pressure improvement equipment
    2. Gas safety equipment against earthquake, etc.
    3. Specified pipes for local gas enterprises
    4. Others
62. Equipment used for introduction of LNG in local gas enterprises (shipping, acceptance, heat-quantity change equipment)
63. 1. Supply pressure improvement equipment (main and auxiliary pipes, gas compressor, holder, transport pipes for local gas enterprises)
    2. Others
64. Earthquake-resistant equipment
65. Improved double-effect absorption water cooler/heater, etc.
66. Equipment for utilization and supply of alternative energy source (acceptance and storage equipment, transport equipment, combustion equipment, cooling equipment, equipment used for introduction of LNG in local gas enterprises)
67. 1. Acceptance and storage equipment
    2. Transport equipment
    3. Combustion equipment
    4. Power-generating equipment
68. Gas production equipment, supply equipment and ancillary equipment (including land and buildings)
69. Gas industry equipment
70. Supply pressure improvement equipment, etc.
71. 1986 budget
72. Billion yen
73. 15.5
74. Limit: 18.0
75. Limit: 33.0
76. Limit: 78.0
77. Limit: 120.0
78. Limit: 31.0
79. Limit: 135.0
80. Limit: 102.0
81. Limit: 40.0
82. Limit: 102.0
83. Limit: 102.0
84. Limit: 102.0
85. Limit: 20.0
86. 7.5
87. Loan ratio
88. 50 percent (land: 30 percent)

89. Hokkaido: 50 percent
Tohoku: 40 percent
90. Loan limit: ¥400 million
Special interest is applied to ¥207 million of above
91. Loan limit: ¥400 million
(¥350 million for alternative energy source)
Special interest is applied to ¥270 million of above.
92. Interest rate
93. First 3 years: 6.30 percent,
Fourth year and after: 6.75 percent
6.75 percent
6.75 percent
Normal interest
Normal interest
94. First 3 years: 6.75 percent
Fourth year and after: 6.80 percent
95. Do
96. Normal interest
97. Normal interest
98. 6.80 percent
First 3 years: 6.5 percent, fourth year and after: 6.8 percent
6.75 percent

Normal interest
99. 6.8 percent
Normal interest

First 3 years: 6.5 percent, Fourth year and after: 6.8 percent
6.75 percent
Normal interest
100. 6.80 percent
First 3 years: 6.5 percent, Fourth year and after: 6.8 percent
6.75 percent
Normal interest
101. 6.85 percent

Normal interest
102. First 3 years: 6.3 percent, Fourth year and after: 6.8 percent
103. When ratio of alternative energy is 40 percent:
5.00 percent
When ratio of alternative energy is 20 percent:
First 3 years: 6.3 percent, Fourth Year and after: 6.8 percent
104. Government fund: 6.3 percent
Public finance corporation: 6.4 percent
105. Remark
106. Time limit: fiscal 1989
Time limit: fiscal 1989
Time limit: fiscal 1989
107. Time limit: fiscal 1989
108. (Note) Normal interest rate is 6.9 percent.

Table 4. Tax Reform in 1986 Related to Gas Industry

	制(1)度名	要(21)求	結(23)果
(2)	（国税）		
(3)	1. 特別修繕引当金	球形ガスホルダー(22)の開放検査費用を制度の対象に追加する	追加を認める。(24)
(4)	2. エネルギー基盤高度化設備投資促進税制 ①高性能吸収式冷温水器 （冷凍能力が毎時3万キロカロリー以上のもの及び台数制御型のもの） ②熱併給型動力発生装置 ③ガス冷房装置 ④ガス利用ボイラー ⑤ガス利用工業炉 ⑥多品種受入型液化天然ガス貯蔵装置 ⑦高効率放射加熱装置（中小企業用） ⑧熱温制御式ガス増熱脱水装置（〃）	制度の創設 (25)	創設を認める (26) (27) 期　間：昭和61年4月1日から2年間 仕組み：対象設備を取得した場合に，取得価額の7%の税額控除又は30%の特別償却の選択適用 対象設備：左記を含め209設備を対象。 （中小企業用112設備を含む） （注1）本制度の創設に伴い，エネルギー利用高率化等投資促進税制は昭和61年3月31日限りで廃止される。 （注2）①，③～⑥及び⑧は従来のスペックアップ。②は従来と同じ。⑦は一般産業用から移行。
(5)	3. 特定ガス導管工事償却準備金	大蔵省からの縮減提案（積立率の引下げ16%→13%）(28)	現行どおり (29)
(6)	4. 公害防止用設備の特別償却	延長 (30)	(31) 〃
(7)	5. 中小企業の貸倒引当金の特例	〃 (32)	(33) 〃
(8)	6. 海外投資等損失準備金	延長 (34)	特定海外経済協力に係る積立率の引下げ（25%→23%） その他は現行どおり (35)
(9)	7. 法人税率の特例	現行制度　法人税率の(36)1.3%（資本金額が1億円以下で所得金額のうち800万円以下の金額については1%）上乗せ	延長（1年間）(37)
(10)	8. 欠損金の繰越し控除	現行制度（各事業年度開始の日前5年以内の事業年度において生じた欠損金額については，当該各事業年度の所得から控除することができる。） (38)	各事業年度開始の日前直近の事業年度において生じた欠損金額については，繰越し控除の対象としない。（昭和64年3月31日までに終了する各事業年度について適用。）(39)
(11)	9. 欠損金の繰戻し還付の不適用		延長（2年間）(40)
(12)	10. 価格変動準備金		廃止 (41)
(13)	11. 特定の資産の買換えの場合の課税の特例		譲渡益の課税繰延額を二割縮減 (42)
(14)	（地方税）		
(15)	1. ガス税	廃止 (43)	現行どおり (44)
(16)	2. 事業税	中小ガス供給業の課税標準の変更 (45)	〃 (46)
(17)	3. 公害防止設備の固定資産税の非課税措置	延長 (47)	延長（2年間）一部縮減あり (48)
(18)	4. 受変送電設備の固定資産税の課税標準の特例	縮減提案（物品製造業等を対象から除外）(49)	現行どおり (50)
(19)	5. 石油ガス備蓄施設の固定資産税の課税標準の特例	延長 (51)	現行どおり（2年間）(52)
(20)	6. 事業所税		税額の引上げ(500円/㎡→600円/㎡) (53)

[Key on following page]

[Key to Table 4]

Key:

1. System
2. (National tax)
3. Provision for special repairs
4. 2. Taxation system for promotion of equipment investment for enhancement of energy foundation
   (1) High-performance absorption water cooler-heaters (those with refrigerating capacity of 30,000 kilocalories per hour or more, or number-controlled type equipment)
   (2) Steam supply and power generating plant equipment
   (3) Gas cooling equipment
   (4) Gas-operated steam generators
   (5) Gas-operated industrial furnaces
   (6) Multi-type LNG storage equipment
   (7) High-efficiency radiant heaters (for small and medium businesses)
   (8) Thermal temperature controlling gas carburetion dehydrator equipment (for small and medium businesses)
5. 3. Contingency reserves for installation of specified gas pipes
6. 4. Special depreciation for pollution-control equipment
7. 5. Exception for reserve for uncollectible account of small and medium businesses
8. 6. Reserves for loss in foreign investment, etc.
9. 7. Exception for corporate tax rate
10. 8. Forwarded deduction of loss
11. 9. End of forwarded deduction of loss
12. 10. Reserve for price fluctuation
13. 11. Exception for taxation in case of purchase of specified assets
14. (Local tax)
15. 1. Gas tax
16. 2. Business tax
17. 3. Exemption of fixed asset tax for pollution-control equipment
18. 4. Exception for assessment basis of fixed asset tax for power receiving-transforming-transmitting equipment
19. 5. Exception for assessment basis of fixed asset tax for oil gas stock facility
20. 6. Business office tax
21. Request
22. Addition of overhaul inspection of spherical gas containers as an object of the system
23. Result
24. Addition approved
25. Creation of system
26. Creation approved

27. Period: 2 years, from 1 April 1986
System: When one of the object equipment is acquired, either 7-percent tax exemption or 30-percent special depreciation of acquisition cost can be selected
Object equipment: 209 pieces of equipment including those listed on the left. (including 112 pieces of equipment exclusively for small and medium businesses)
(Note 1) Following the creation of this system, the taxation system for the promotion of efficient energy utilization was abolished on 31 March 1986.
(Note 2) Equipment in items (1), (3) to (6) and (8) are subject to specification improvement compared to conventional models. Specification of (2) is the same as before. (7) is transferred from general industrial use.
28. Proposition of reduction from Ministry of Finance (reduction of reserve rate from 16 percent to 13 percent)
29. Same as at present
30. Extension
31. Do
32. Do
33. Do
34. Extension
35. Same as at present, except the reduction of reserve rate related to specified overseas economic cooperations (from 25 percent to 23 percent).
36. Current system, plus addition of 1.3 percent of corporate tax (1 percent for income of no more than <8 million for firms with a capital of no more than <100 million)
37. Extension (1 year)
38. Current system (Loss generated within 5 years prior to the starting date of each business year can be deduced from the income of the business year.)
39. Loss generated in the previous business year to the starting date of a business year cannot be forwarded for deduction. (This is applied to business years which end before and including 31 March 1989.)
40. Extended (2 years)
41. Abolished
42. Reduction by 20 percent of tax deferment of capital gains
43. Abolition
44. Same as at present
45. Reform of assessment basis for small and medium gas-supply firms
46. Do
47. Extension
48. Extended (2 years), with partial reduction
49. Proposition of reduction (exclusion of good manufacturers from object)
50. Same as at present
51. Extension
52. Same as at present (for 2 years)
53. Increase of tax amount. (from ¥500 per square meter to ¥600 per square meter)

20157/8309
CSO: 4306/2610

NEW MATERIALS

DEVELOPMENT TREND OF MOST ADVANCED MATERIALS

Tokyo NIKKO MATERIALS in Japanese Apr 86 pp 5-13

[Text] MITI's Agency of Industrial Science and Technology (AIST) has 16 affiliated research institutes in various regions in Japan, from Tsukuba Academic Research Town on down. They are working on diverse research themes for the purpose of enhancing Japan's standard of industrial technology.

More than 500 themes are involved for ordinary, basic research, 100 themes under 18 categories for task-oriented special research, and project research themes for large-scale projects, the Sunshine Project, and the Moonlight Project.

Research and development on materials is under way at these research levels. Among them, at the special research level, many separate themes are being dealt with under categories like "new materials technology" and "polymer engineering technology." For project research, the theme of "new materials" has been taken up as part of the basic research and development system for next generation industries, which started in fiscal 1981. Full-scale research has been launched in the fields of fine ceramics, high-efficiency high-polymer materials, high-efficiency crystallization-controlled alloys, and composite materials. Development of materials is regarded as a key technology also in such other projects as the Sunshine Project, the Moonlight Project, and large-scale projects. The research institutes are actively engaged in development with the cooperation of private companies.

Recent achievements to be presented at "Frontier Technology '86" follow:

Hokkaido Industrial Development Research Institute Studies "Sioc," Heat-Resistant, Corrosion-Resistant Inorganic Fiber

"Sioc," an inorganic fiber, is a crystalline fiber with a "large aspect" ratio (diameter: 300-30 nm, length: more than 100 μm). In the air, it is proof against temperatures higher than 1000°C, and can resist strong acids, including hydrofluoric acid, mixed acids, and alkali liquids.

The fiber is produced by sintering silicic acid and saline minerals, and charcoal, or more specifically, quartz sand, chaff ashes, chalk, etc., at temperatures over 1400°C (patent pending).

The product looks like sponge and is springy. Its component is a fibrous compound made of silicon, oxygen, and carbon. But its component ratio and composing mechanism are still not understood. In fact, the details of Sioc's physical and chemical characteristics and its evaluation are being tested.

Hokkaido Industrial Development Research Institute Studies Quantitative Analysis of Thin Ceramic Films by XPS

Recently, development of ceramic coating materials has progressed rapidly. Analysis is one of the most important techniques for research and development on these materials. It is extremely difficult, however, to analyze thin ceramic films, because the analysis of ceramics itself is difficult by nature. This research institute is proceeding with research on the quantitative analysis of thin ceramic films by the surface analysis method. The example to be discussed here is the analysis of TiN by the X-ray photoelectron spectroscopic method (XPS). TiN is produced by reactivity r.f. spatter method. Analysis of film was carried out on a substrate to which negative bias voltage was applied in order to control the composition and the crystallinity. As the bias voltage was increased, the film produced changed color from black to gold, and then to reddish gold. X-ray analysis tells us only that the crystal form of all these films is TiN type. But when the ratio of Ti and N was analyzed by XPS, it was learned that there was considerable lack of N in black films with small bias. Suddenly after the bias voltage exceeded a certain level, the films became pure TiN. This phenomenon is highly repeatable. As a result, substrate bias was proved useful for component control.

Analysis is very often a good research foundation. Progress of analyzing technology will accelerate development of materials further.

Chemical Technology Research Institute Studies Conductive Langmuir Brodgett's Films (LB)

Various organic super-thin films are being tried as electronic materials. Among these, LB films are attracting special attention because their film thickness is as thin as molecular level, and the molecules contained in the film are orientation-controlled. There have been LB films with electric insulation characteristics or that of semiconductors. However, in order to make various electronic devices using LB films, it is imperative that LB films, which have highly conductive characteristics like metals, be produced.

To produce conductive LB films, formation of monomolecular films which are stable on the surface of water is necessary. It is also important to give the films the function of conductivity. As is illustrated in Figure 1, a charge-transfer complex compound with long chain hydrocarbon radicals was composed. Monomolecular films were then produced on the surface of the water. More than 30 layers of the films were accumulated on a substrate. As a result, organic super-thin films with chemical stability and conductivity much higher than others were obtained. The thickness and the conductivity

of these films were about 0.1 μm and 0.01-0.1 S/cm, respectively. The conductivity is not as high as that of metals, but it should be raised by using new charge-transfer complex compound substrates and by improving the conditions of film production.

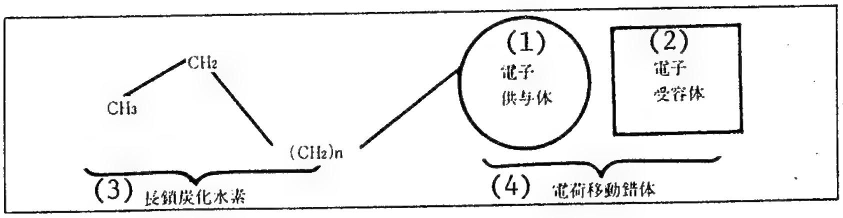


Figure 1

Key:
1. Electron donor
2. Electron receptor
3. Long chain hydrocarbon
4. Charge-transfer complex compound

Chemical Technology Research Institute Studies Silicon Carbide Porous Bodies

Silicon carbide is attracting attention as a new material for structural and functional materials, because of its excellent physical and chemical properties, such as high abrasion-resistance, corrosion-resistance, and heat conductivity. However, regarding its use for functional materials, silicon carbide with adequate mechanical strength had a specific surface of just 1-2 m^2/g, and a pore volume of only 0.2 ml/g. Therefore, its usage as a porous body was quite limited.

The silicon carbide porous bodies to be exhibited [at Frontier Technology '86] are porous silicon carbide sintered bodies with a pore volume in the range of 0.2 ml/g and 2.0 ml/g, a specific surface above 3 m^2/g, and an average compression strength above 300 kgf/cm^2. Moreover, the sintered bodies can be shaped into plates, pipes, and pellets as in the exhibit.

It is also possible to form a coating of silica and (or) alumina on the surface to further increase the surface area of these porous bodies, or to raise their affinity to other substances. The specific surface of the porous bodies to be exhibited is enlarged to about 50 m^2/g, while their pore volume and strength are maintained. This improvement was made by forming a lamination coating of silica and alumina in submicron order on the surface of the silicon carbide porous bodies. These are new materials which are expected to be used for heat-resistant catalyst carriers.

Patent pending. Technical instruction, one company.

Chemical Technology Research Institute Studies Ruthenium Catalyst for Partial Hydrogenation

A new catalyst, which displays excellent performance in economically synthesizing cyclohexene out of benzene through a partial hydrogenation

reaction, has been developed. The catalyst is just a mixture of silica and alumina, with ruthenium, an activating agent. Its production method is different from conventional ones.

It is already known that ruthenium is a suitable catalyst for partial hydrogenation of benzene. Ruthenium catalysts used to be produced by the usual impregnation method. With this conventional catalyst, a large amount of alkali and cobalt sulfate, in addition to the catalyst, were added at the time of hydrogenation reaction, in order to obtain cyclohexene. The conventional catalyst, however, was not practical, because those additives corroded reaction receptacles and accelerated the deterioration of the catalyst.

On the other hand, the new catalyst does not require corrosive additives at all, which is one of its features. The new catalyst is produced by chemically mixing ruthenium chloride and alkoxylan or aluminumalkoxide in a diol solvent. Figure 2 shows the hydrogenation reaction of benzene by the new catalyst, and Table 1 contains the results of hydrogenation by the catalyst and impregnation catalysts.

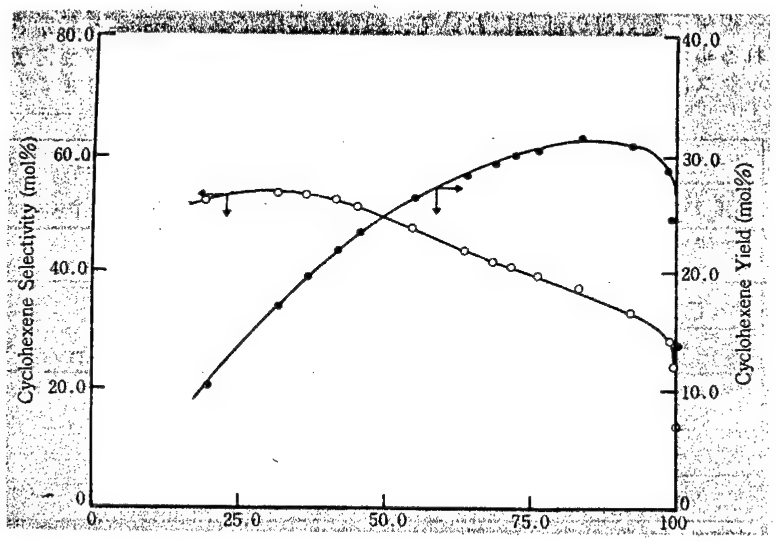


Figure 2. Partial Hydrogenation Reaction of Benzene by Chemically Mixed Catalyst of 2%Ru-0.2%Cu-SiO_2. Conditions of reaction: same as in the table.

As seen in the figure and table, the new catalyst produced by the chemical mixture method displays an excellent cyclohexene production performance, and does not deteriorate easily with repeated use. Furthermore, it showed that it has a higher performance in the partial hydrogenation of the aromatic group than benzene, especially the alkylbenzene group.

Table 1. Partial Hydrogenation Reaction of Benzene by Various Ruthenium Catalysts

Catalyst and Preparation	Linkage Solvent	Max.Yield (%)		Max.Selecct. (%)	
		⌬ Conv.	⬡ Yield	⌬ Conv.	⬡ Select.
2%Ru-SiO_2 *	Ethyleneglycol	86.8	27.0	37.0	40.7
2%Ru-0.2%Cu-SiO_2 *	Ethyleneglycol	83.3	31.4	32.1	53.6
2%Ru-Al_2O_3 *	Pinacol	42.7	14.2	33.1	38.2
2%Ru-0.2%Cu-Al_2O_3 *	Pinacol	76.5	20.8	33.6	47.3
2%Ru-SiO_2 **	———	64.3	8.6	11.5	48.8
2%Ru-Al_2O_3 **	———	54.5	5.3	5.6	23.3
2%Ru-Al_2O_3 ***	———	72.7	27.2	3.9	58.2

Conditions of reaction: benzene, 160 ml; water, 100 ml; temperature, 180°C; pressure, 70 kg/cm^2; catalyst, 1 g.
* Chemical mixture method, ** Impregnation method,
*** Impregnation method catalyst + cobalt sulfate

Product Science Research Institute Studies Carbon-Fiber Reinforced Aluminum by CVD Method

Recently, by embedding various fine fibers in the materials of matrixes, mechanical characteristics which would not be achieved with bulk materials have been obtained. This includes carbon-fiber reinforced metal matrix composite materials. Especially, carbon-fiber reinforced aluminum is a promising heat-resistant, lightweight, structural material for space and aviation.

Generally, there are a number of compounding methods for carbon fibers and metal matrixes.

The Product Science Research Institute has developed technology to produce aluminum-coated carbon fibers by a low pressure MO (Metal Organic)-CVD method. (Patents pending, No 59-164155, No 59-163310)

In this method, the surface of carbon fibers can be coated evenly with aluminum at the relatively low temperature of 260°C at the rate of 0.1 μm/minute.

At the moment, the Product Science Research Institute is proceeding with research on carbon-fiber reinforced aluminum by the CVD method, focusing on the following.

1. Understanding thermal dynamic reaction mechanisms on the interface of fibers and matrices.

2. Development of barrier coating to control reaction products on the inferface of fibers and matrices.

3. Molding, processing, and characteristic evaluation methods of the products developed by the institute.

Nagoya Industrial Technology Research Institute Studies High-Strength Mullite Sintered Bodies

Mullite ($3\ Al_2O_3 \cdot 2\ SiO_2$) is known for its excellent resistance against creeps and thermal impacts. But the characteristics of mullite have not been given full play, because fine sintered bodies with high purity are hard to obtain.

This institute improved the purity of the materials and fine-grained them by an atomization pyrolysis method and a metallic alkoxide hydrolysis method. At the same time, it strictly controlled the component ratio of alumina and silica. The institute succeeded in producing fine mullite sintered bodies with high-temperature strength by no-pressure sintering.

Although the strength of mullite varies according to the component ratio of alumina and silica, the sintered bodies developed by the institute show normal temperature strength of 380 Mpa, two to three times that of conventional ones, and high-temperature strength of 570 Mpa, three to five times that of the normal.

No other oxide material has equal high-temperature strength. Moreover, they can be produced easily at low cost. Apart from use as high-temperature structural materials, diverse applications in many fields are expected.

Nagoya Industrial Technology Research Institute Studies Ultra-Plastic Fine Ceramics

Although fine ceramics have excellent heat resistance and corrosion resistance characteristics, they are rigid and brittle. Thus they were thought not able to transform. Recently, however, it has been discovered that some fine ceramics have ultra plasticity.

Ultra plasticity is a phenomenon of polycrystalline solid materials' unusual elongation (more than several hundred percent) under low stress in tensile tests. The ceramic whose ultra plasticity was recognized is partially stabilized zirconia. This ceramic is used as a material for knives and machine parts, because it has high strength and toughness at room temperatures. If tension is applied to this material gradually at 1450°C, $10^{-3} \sim 10^{-5} S^{-1}$, ultra-plastic transformation of more than 160 percent is possible.

Partially stabilized zirconia is composed of very fine tetragonal zirconia crystalline grains whose average diameter is 0.3-0.4 μm. Round and small, the grains slide easily on one another (grain interface slide). This is considered to be the reason for the ultra plasticity.

Utilization of the ultra plasticity phenomenon will enable hot working, press processing, and bulge processing of ceramics. In addition, they can be used for ultra-plastic junctions.

Features of Ultra-Plastic Processing

1. Complicated curved surface. Suitable for producing parts where high precision is required.

2. The complicated shape of molds can be reproduced on products. Using molds with an inner surface like a mirror is a useful surface finish.

3. Suitable for mass production, because the processing speed is within a practical range.

Nagoya Industrial Technology Research Institute: Research and Development on Production Technology for Ceramic Cores by Injection Molding

Technologies for ceramic cores used for monocrystalline cast blades of gas turbine engines are kept secret worldwide, because they are important for the performance of aircraft. Likewise, companies keep secret the technology of injection molding of pulverulent bodies like ceramics, as it is a way of developing uses for new materials. Equipment required for development is also kept secret. In order to promote research and development of monocrystalline casting technology related to the high-performance crystallization-controlled alloy project, part of the basic R&D system for next-generation industries established by MITI, the cast laboratory of the institute is doing research by remodeling marketed resin molding devices.

Production Processes of Ceramic Cores (Injection Molding Method Using Existing Equipment)

In the injection molding method, ceramic pulverulent bodies are not molten fluidized, but linkage materials are molten, fluidized, pressurized, and cast into a metal mold through a nozzle by injection filling.

Osaka Industrial Technology Research Institute Studies Epoxy System Composite Materials by Reaction Injection Molding Method

Reaction injection molding is a new energy conserving molding method. In this method, there is more than one liquid material which has reaction activity of polymerization caking following rapid reaction after mixing. The materials are weighed, mixed, and immediately injected into a mold, where the reaction takes place. Thus, plastic molding is made in just one process.

The sample is an epoxy system composite material, based on this injection method, made in the following way. Alamide cloth and a hybrid reinforcing material made by mixed-weaving alamide and carbon fibers placed in a mold in advance. Epoxy compounds, which are the main agent, and amine compounds, a hardening agent, are mixed according to weight, and injected into the mold. The epoxy system composite material is produced.

Because the raw materials are liquid, with low viscosity, they get wet and impregnate into reinforcing materials easily. Accordingly, interface junction with reinforcing materials can be improved, and high-performance composite materials can be produced easily.

Alamide fiber reinforced plastics (AFRP) excel in specific strength and impact resistance, but their elasticity is not high. Elasticity can be improved by using carbon fibers, which have high elasticity, in combination. Table 2 shows the physical properties of these composite materials.

Table 2

Samples	Reinforcing materials (Vol%)	Specific gravity (g/cm^3)	Bending strength (kgf/cm^2)	Bending elasticity (kgf/cm^2)	Impact strength (kgf-cm/cm)
No reinforcement	0	1.13	1160	2.88×10^4	28.4
AFC	43.0	1.38	4900	20.8	92.4
ACC	42.3	1.41	3730	31.3	65.1

Osaka Industrial Technology Research Institute, Nippon Quartz Glass Co., Kondo Silvania Co. on Surface Light Sources

EL boards and diffusing board systems which incorporate fluorescent lamps behind the boards are conventional surface light sources. However, they have problems with brightness and with even distribution.

The light source discussed here is a surface radiation light source with the following features: 1) Even luminance distribution, 2) no heat discharge, 3) no electric noise, 4) good light adjustability.

Figure 3 illustrates how it works. Light emitted from a light source (1) is introduced into a transmission board (3) by the lens function of a ring transmission light (2). Diffusion layer (4), which is painted on the reverse side of the transmission board, causes diffused reflection of the light. Luminous intensity distribution can be adjusted by the density of the paint. Either even or uneven distribution of luminous intensity is possible.

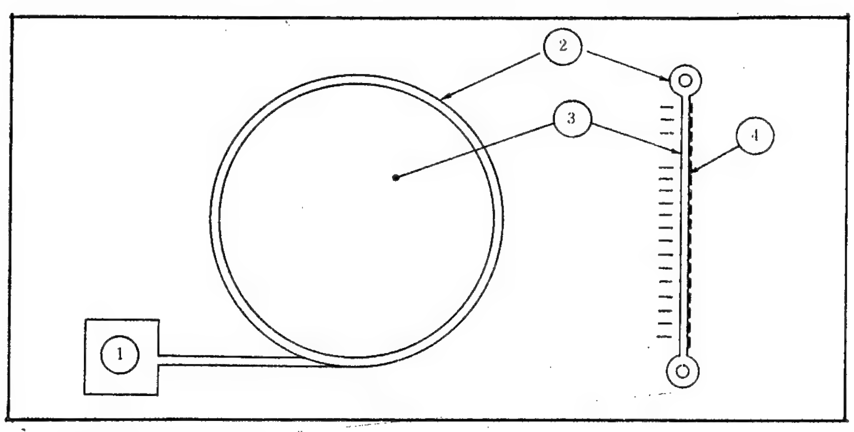


Figure 3

If these features are utilized, the surface radiation light source can be used as a light source for various printing, exposure, and advertising illuminations.

Osaka Industrial Technology Research Institute Studies High-Reflex Mirrors for Lasers

Solid and gas lasers in the region of infrared and vacume ultraviolet are beginning to be used widely for creation and processing of materials. Especially, excimer lasers are the focus of active development toward larger output, higher repeatability, and longer life. At the same time, basic research on X-ray lasers is about to be realized. Various SR light sources are being built one after another. Under these circumstances, development is possible of photo-elements, which are useful for high-energy high-luminance light. High-efficiency reflex mirrors and diffraction grating must be composed of light new materials with excellent material strength and ultra-smooth surfaces which are not easily distorted by the stress of laser heating.

Mirror materials made of basic materials, such as isotropic high-density graphite or polycrystalline silicon, coated with high-hardness thin films of light element compounds, like SiC, SiN or BN, have excellent heat resistance and high hardness. They are used as base materials for reflex mirrors and diffraction grating with extremely high performance of heat transformation index and toughness.

Osaka Industrial Technology Research Institute has completed compounding technology to structure base materials with such performance and thin films en bloc. This technology enabled the formation of fine carbide films, nitride films, and boride films with excellent thermal impact resistance through gas reaction. By accumulating these techniques, Osaka Industrial Technology Research Institute developed new high reflex mirrors for high luminance light, composed of high density graphite/SiC/SiC-O/SiO_2/multi layers.

Shikoku Industrial Technology Research Institute Develops Alginic Acid Fiber Paper

Alginic acid is a component of compounds between the cell walls of brown algae. It is a regular polyuronic acid composed of β-D-mannuronic acid and α-L-gluronic acid. It is already known that alginic acid can be spun and made into fibers by a wet method. The fibers could not be woven into cloth, however, because their single fiber strength was insufficient.

The alginic acid fiber paper developed by the institute is made of alginic acid fibers which are cut to 3-5 mm. If length/diameter ratio is appropriate, the fibers join together during drying, and become a sheet, i.e., paper, by a kind of self-adhesion. The technology takes advantage of this phenomenon.

Although the new paper is made solely of alginic acid, the appearance barely differs from ordinary paper. Its features and range of use are as follows. 1) Alginic acid has a hemostatic effect, and is harmless even if taken into a body. Due to this physiological fact, the paper's applications to medical and hygienic materials can be expected. 2) Isolated alginic acid catches heavy metallic ions and generates chelate. The paper can be used as a chelate exchanger. 3) As alginic acid can contain enzymes and microorganisms, it can be used as an enzyme fixed carrier in the shape of fibers or sheets. Applications to highly efficient bioreactors and biosensors can also be expected. Alginic acid fiber paper is a new "functional paper" which is different from conventional paper in that if it is made alkaline, it becomes water soluble, and if it is made into calcium salt, it does not have a hypergolic nature.

Osaka Industrial Technology Research Institute on Electric Contact Method of Ceramics

The electric contact method was developed jointly by Osaka Industrial Technology Research Institute and Daihen. Generally, ceramics are insulators, and it was believed that, unlike metallic materials, electric contact of ceramics was impossible. However, some ceramics show some electric conductivity at higher temperatures. Even if ceramics have no electric conductivity, the temperature of their junction parts can be raised by electric energy, if appropriate junction agents are used to give them electric conductivity.

In the electric contact method developed by the institute, junction parts are heated to connect them by electric discharge through various gas flames. The electric equipment needed for the electric discharge in gas flames and electric resistance at junction parts is medium size with high voltage and small electric current. Gas flames are also used to alleviate the thermal impact of local heating of ceramics.

Kyushu Industrial Technology Research Institute Develops Foamed Aluminum

Foamed aluminum is a kind of porous metal made by uniform dispersion in aluminum of gas generated through pyrolysis of a foaming agent. While foamed urethane, foamed polystyrene high-polymer foamed bodies, aerated concrete, and foam glass inorganic foamed bodies are used as industrial materials in various fields, metallic system foamed bodies, such as foamed aluminum, are not yet industrialized. The foamed aluminum developed by the institute is attracting attention because production is relatively easy.

Foamed aluminum is "lightweight," because of foam (specific gravity: 0.3, or one-tenth of aluminum, one-third of soot), "nonflammable" like metals, and has high "sound absorption."

With the above characteristics, foamed aluminum can be used in structural walls, ceilings, partition wall materials, noise prevention factory walls, and inner layers of ceilings. It can also be used as walls, ceilings, and floors in computer rooms, because it has an electromagnetic wave shield

effect. Furthermore, it is expected to be used as a noise barrier on expressways and Shinkansen bullet trains of the Japan National Railways, and as inner layers of tunnels. Foamed aluminum is a new material with possible uses in a wide range of fields, due to its distinctive functions.

Thus far, two companies have started production of foamed aluminum. They plan to proceed to development of large-size foamed aluminum when demand increases.

20132/6091
CSO: 4306/3589

NEW MATERIALS

HISTORY, STRATEGY OF HOYA CORPORATON DETAILED

Tokyo KOGYO GIJUTSU in Japanese May 86 pp 24-28

[Interview with Tetsuo Suzuki, president of Hoya Corp., by Shoroku Kato, councillor to the minister's Secretariat, MITI; date and place of interview not given]

[Text] [Kato] President Suzuki, since you are playing important roles as the chairman of the Japan Glass Products Industry Association and the representing manager of the New Glass Forum and have achieved many business successes as an engineer-oriented manager, I would like to hear about your invaluable experiences, also reported in this issue of KOGYO GIJUTSU.

In particular, the history of Hoya Corp. shows that it has undergone a dramatic change since its establishment in 1940 as the Toyo Optical Glass Manufacturing Co., an optical glass weapons manufacturer for the Navy. I have heard that recently you have produced successively particularly highly value-added products. First of all, please explain the history of your company from its beginning stage to the present focusing on the experiences you have had.

From Optical Glass to Electronics Enterprise

[Suzuki] As you have pointed out, our start was to develop optical glass. The optical glass industry at that time was just like the advanced technology of that time, and Japan had no camera industry as a user industry. We have been a research/development type industry since that time.

At first it was optical glass, then we next developed crystal glass immediately after the end of the war.

The U.S. forces in Japan were the first to buy and use crystal glass which contributed to the successful industrialization.

The third product we developed was eye glasses. We entered the eye glasses business taking full advantage of our optical glass technology. At that time, it was generally recognized that foreign-made glasses were superior. However, since we felt that optical techniques were advanced we could manufacture glasses lens on a full-scale basis, and went into the eye glasses business.

This business was also successful and has developed into a large-scale concern.

And then, the fourth business that was developed as the electronics enterprise. This is also the optical glass technique where the precision polishing technique was the basis in developing photo-masking for semiconductors (a technology that allowed minute circuits to be drawn on a glass negative). The development was successful and lead to our entering into the field of electronics. This has been our course.

[Kato] That is, currently you have four industrial fields lined up. Is that right?

A Large Fish in a Small Pond

[Suzuki] That is right. Our strategy was to have each line of business rank at the top of the respective industry one by one instead of coming out at once. Since entering a new field is extremely risky, it was our policy to try to fight only the winning battles.

It has been the policy since my becoming president that I would run the business in fields where I can make use of our own technologies, thereby establishing our superiority in competitiveness. Any line of business I run should rank top in the industrial circle, and any line of business that fails to rank at the top despite our efforts should be given up. I have often told the company employees to "become a large fish in a small pond." Being a small fish in a large pond does not easily stabilize our business and involves persistent threats from strong competitors. In other words, it was having selected unique fields rather than general ones up to now.

[Kato] It looks like that you have succeeded in each line of business you undertook. What was it like technically in the background of catching up with or surpassing your competitors?

[Suzuki] One of the major reasons we maintained the largest global scale in terms of optical glass is that in 1951 and beyond we were able to apply the considerable high-level optical technologies of the Japanese wartime Navy to cameras. Up to that time, German cameras had been the best in the world; we were behind Germany in terms of the basic science in lens. In the early stage, the cameras produced were only imitations of the Germans, but with approximately 1955 as the beginning, the camera industries of Japan became competent.

A decisive lead was gained when a computer-based design technology was used in lens designing. Then electronic components were incorporated into the cameras. On the other hand, German camera manufacturers had preserved the master system and produced their cameras mostly based on craftmen's skills. In the case of Japan, manufacturers made enormous efforts for industrial engineering and design technology when high-performance products became

available at very low cost and in great quantities. This is due to the talents of the Japanese industries.

[Kato] Although it is generally accepted that Japanese industries are talented at production techniques in the very new, creative technology instead of conventional production techniques is required in new fields such as electronic materials. I understand that you are gaining a substantial world-wide market share in that field. With Germany and the United States having considerable basic technology accumulations already in this field, how are their situations?

[Suzuki] When we first developed a masking substrate for photomasking, just in the case of optical glass, there were very few Japanese users. Most users were from the United States since at that time in the United States they were beginning to make semiconductors at Silicon Valley. However, some years elapsed and Japanese manufacturers invested a great amount of money in semiconductors, and those masks used in the United States could also be used in Japan. Moreover with the level of integration increasing rapidly, we have now become the world's largest in scale for semiconductor masking material.

[Kato] For example, I understand that your company ranks third in the glass industry after the Corning Co., which developed heat-resistant glass, and the Schotzt Co. of West Germany. But, I suppose both the Corning and Schotzt companies have naturally had similarly started business in the electronics equipment and optics fields that we do not hear much about.

[Suzuki] Yes, they have. However, it is because our efforts were concentrated 10 times greater than theirs. And then we developed a very fine polishing technology and production technique that permitted quantity production with excellent yield rates. As a result, our products found wide use in the world's semiconductor industries because of their stable quality and lower costs.

[Kato] In the high-technology fields, presently, your company seems to be advancing into electronics, medicine, and biotechnology. For instance, when you made inroads into new fields such as ultrasonic delay-line glass, or photosensitive glass, laser glass, or Faraday rotary glass, your company must have been advancing focused on basic technologies.

We are amazed at your successive successes in new fields that are quite different from such conventional optical glass or crystal glass. It is believed that unusual inspiration, determination, and preparation were required in entering new fields.

Modernization of Management--Three Responsibilities of the President

[Suzuki] It was in 1960 when I realized the necessity of modernization of management, and carried on as an organization named Hoya Glass for 25 years up to 1984. During that time, our theme was to pursue the possibilities of glass, and four research laboratories were constructed. Research on these

themes started at those laboratories gradually became fruitful, their application became the current electronic materials, and the recent glass products for optical industrial use.

After 25 years I found that the managerial theme of pursuing the possibilities of glass was insufficient. Recognizing that the company should be restructured toward the 21st century prompted me to change the company name from Hoya Glass to Hoya Corp.

We have not stopped pursuing the possibilities of glass, of course, but our management target has extended beyond glass into the domain of optics industry, and a 10-year vision has been created.

The largest pillar is electronics, especially optoelectronics, followed by medical products. We have set optical-medical products as our target; we will begin research and development, and will develop the product. These are our aims.

We had been classified under "ceramic/pottery" in the stock market listing, but we transferred to the "precision machinery" section the year before last in view of the actual status of our business.

[Kato] In heading toward research versatility and industrial diversification, the workforce is believed to be the main point. I understand that as president you were noted for scouting a large amount of outside manpower. For example, Dr Izumitani from the Osaka Industrial Laboratory was one individual. Likewise you have brought in experts from outside and have trained corporate personnel, and in both these areas from a long-range point of view it is believed that efforts have been made to maintain an excellent workforce. We would like to hear more about that for our references.

[Suzuki] Looking back these 25 years, employee education was certainly very important. We were a small-town workshop then, and our annual sales was only Y500 million when I became president. We were just a factory down the street. I was determined to make a company-like corporate. For this purpose what I felt most important was the personnel.

Therefore, I made efforts to recruit personnel from outside for those not available within the company while on the other hand, training the employees within the company. I am certain that my efforts were successful.

Furthermore, since our retirement time is nearing, we must transfer our duties to the new successors. I have set up a management school last year and began passing our experiences on to the next generation group on a man-to-man basis.

Having been president for 25 years, I believe that the responsibilities of the president can be classified into three duties: First, is to leave a considerable fund accumulation in the company; second, to leave a competitive, strong operation; and third, to leave the company a cultural enterprise or,

shall we say, an organizational climate that can ensure the continuing success of the company.

I believe that the first and second of the themes have more or less been done after exerting my best. An organizational climate must be developed that will permit the ongoing success of the company after our retirement. Since such a workforce must be developed for the company's posterity, the private school was initiated.

Technology Innovation and Innovation of Management

I have been thinking recently that the time has come when technology innovation has a very great impact on management; technology development strategies themselves become the management strategies.

For that reason, it is necessary to concurrently promote technology innovation, and management innovation must keep abreast. What I consider an extraordinary problem is how technology achievements can be translated into management achievements.

[Kato] In the case of your company, have you not promoted these two in parallel and concurrently?

[Suzuki] Yes, we have. From now on, I shall place emphasis on technology innovation, spending five to six percent of the sales on research and development expenditures. Such expense imposes a very heavy burden on management, but it will be carried out. Since this must be justified by management achievements, it is our way of thinking to promote management innovation in parallel. I feel it is one-sided if only technology innovation is promoted. In addition, the management framework must be changed.

A new in-company venture system recently introduced as a trial method I think is very good. It is to let that particular area be an independent organization and a system saying management innovation sounds complicated, but the point is the innovation of the personnel system. The so-called Japanese way of management fostered for 30 years actually is a hindrance to a new business. For example, to give better salaries to the technicians is very difficult under the existing personnel system.

We had set up a special path for the specialists, especially for those in research and development, and designers are in the specialist course. We have three courses: specialist, management, and general; with specialists and management personnel being promoted quicker than the personnel in the general category.

However, those with responsibilities who do not do well are downgraded to the general course.

Starting this year, there will be three ladders for success in the course when a person decides for himself/herself which course to take.

[Kato] When you have excellent research, excellent achievements result from research. And to make good use of such achievements, setting the direction for research and evaluating the achievements are considered very important.

In the case of your company, I assume that the setting of direction for the research and the evaluation have been working extremely well because of the successive outstanding technology.

[Suzuki] We believe that research and development will succeed if a certain amount of manpower and capital funding is invested. However, research and development is not our objective in itself. We must make it into a new product at all possible cost, if possible expanding as a new enterprise, making it into a large-scale basis. Otherwise, management diversification is impossible.

Therefore, it is true that there are a variety of research themes done at our laboratories, but are subjected to considerable control. In many cases, research targets in fields the company wishes to enter or new products the company wants to produce are set beforehand, and the required research followed. The targets of development were ahead of our research.

[Kato] I see; optical-electronics was first. Next, the medical products followed, and then the bio-products. Changing the subject, how have you taken advantage of the cooperation among industry, universities, and the government, especially in utilization of the national test and research institutions?

[Suzuki] We have been obliged to the Osaka Industrial Technical Testing Laboratoru (Daikoshi), which made remarkable achievements in developing optical glass during wartime. Such success of the Japanese optical industry is greatly credited to its research. We plan to use and cooperate with the national test research institutions in the future to the fullest extent.

[Kato] How do you see the development of the New Glass Forum which you have been actively promoting? I believe there are many developments that lead in those fields of your company that could be found in your research and operations.

[Suzuki] I believe the Forum has a good possibility. Although glass is a very ancient material with a 4,000-year history, the future is new in terms of amorphous material. Amorphous material is very new among inorganic materials and there are areas in which it is still unknown. In addition, there have been new innovations in the basic science and in the manufacturing method of glass during the past 10 years. If we use them in the high-technology era, glass as a new raw material is very promising.

Since new glass may be able to find possible applications in various fields, the glass industry in general should cooperate in investigating this possibility. Furthermore, we had requested the administration to form a joint

industry-government-academic body because the power of the glass industry alone is weak. The policy to develop a new glass has fostered the New Glass Forum.

[Kato] How should we visualize the dream of the new glass in the 21st century?

[Suzuki] I believe production is estimated to reach about Y1.5 trillion as a matter of course. The capability is beyond that of one or two companies, so it is necessary for all companies concerned to participate. Because of that they will promote the development of new glass while cooperating on one hand and competing on the other, with varying lines of business being pursued. In the course of development, each will find promising materials respectively. I have such a dream.

For some time to come, optical-electronics will continue to be active. Biotechnology will be next; for example, the artificial bone and enzyme carrier. Minute holes will be made in the glass, micron-size. They will be filled with enzymes.

[Kato] Glass capsules?

[Suzuki] Yes, that is so, the so-called enzyme carrier or the separation membrane. New glass will be used for separation membranes replacing the functional polymer currently being used. New glass will find many other applications. The progress of biotechnology will require suitable new materials. That in itself will support the leading industries instead of forming new glass industry. In the future, space technology will require new materials.

[Kato] I am looking forward to the expanded use of glass in various fields. Your continued activity is solicited. Thank you very much for your opinions.

20,156/9599
CSO: 4306/3612

NEW MATERIALS

NAGOYA FINE CERAMICS FAIR DESCRIBED

Tokyo KOGYO ZAIRYO in Japanese May 86 pp 17-19

[Article by Hajime Saito, professor at Toyoda Institute of Technology]

[Text] The Fine Ceramics Fair in Nagoya has marked its fourth year. Among the three sponsoring organizations, the Chubu Regional Science and Technology Center was replaced by a nationwide body, the Japan Fine Ceramics Center (JFCC). The number of participating companies to the fair has been increasing each year. This year, the number reached 200, a 40 percent increase from last year's 140 companies. At the same time, it can be said that the fair has been internationalized, as some 40 companies, 20 percent of the total, participated from abroad.

As a result, Fukiage Hall, the site of the three previous fairs, could not house all the exhibits this year. The main Matsuzakaya Department Store was also used as a second site. The first site was used for exhibits for participating companies, and basic research exhibits for universities and national and public research institutes. The second site was thematic. Visitors to the first and second sites totaled 290,000, a 25 percent increase from last year.

In this article, I would like to outline the Fine Ceramics Fair '86, centering on some interesting points.

Companies' Exhibits

The state of the art of fine ceramics can be outlined as follows. The composition selection of materials for structural ceramics has almost been finished. Oxide types are already in practical use, while development of carbides and nitrides out of non-oxide types is making rapid progress toward practical use. Others, like borides and silicides, are still in production technology development. Regarding functional ceramics, which were originally developed from experience, new types are expected to be developed by material designing through the application of materials science. Existing functional ceramics are said to be in evolution toward multifunctions.

Some of the features observed in companies' exhibits at the Fine Ceramics Fair '86 will be discussed below.

Concerning structural ceramics in general, practical application of materials has progressed. At the same time, some new materials have appeared. Meanwhile, functional ceramics have been incorporated in systems. Through this technology, it seems that new functions and multifunctions have been created, and this in turn facilitates development of new materials. Concrete examples will be cited below.

Main structural ceramics used for synthesis of materials are wiskers, nitrides, borides, high-functional oxides, and granules of artificial bones. Wiskers are high-strength, thermal-resistant, single-crystal fibers. They are important for composite material substrates. They are used to enhance the strength and toughness of structural materials, and will be needed for ceramic engines in the future.

Wiskers produced so far are mainly silicon carbides. Their performance as fibers is not high enough, and they are expensive because a discontinuous production method is employed. Wiskers exhibited at the fair this year are made of inexpensive materials. They were produced on the premise that it will be possible to make them at low cost by a continuous method. Their characteristics can be appreciated. It is likely that silicon nitride wiskers will be developed in the same way in the future.

Aluminum nitride is used for structural ceramics. Theoretically speaking, substrates with high thermal conductivity and better quality than alumina can be obtained from pulverulent bodies of aluminum nitride. However, their functions were not fully utilized, because much oxygen unavoidably was mixed into them at the time of synthesis from chemical combinations. However, low-oxygen content high-purity pulverulent bodies have been synthesized, and some companies exhibited pulverulent bodies and substrates of aluminum nitride at the fair. Boride materials in general have a metallic luster, a high melting point, high strength, high electric resistance as a metal, and chemical stability.

Among other things, titanium and zirconium borides are being scrutinized as industrial materials. Basic research has been conducted hoping for active application in the next century. At the fair, ceramic heaters made by composing zirconium boride and silicon carbide were presented for the first time. Due to their wide range of electric resistance values and rapid increase in temperature, they are expected to be used variously in the future.

From oxide types, mullite and cordielite are attracting attention as materials for thermal exchangers, thermal reactors, and catalytic converters. Existing products, however, have problems in terms of strength.

This can be attributed to the low purity of these sintered bodies and lack of homogeneity of their fine structures. However, high-strength sintered bodies can now be obtained by sintering homogeneous fine grains of high purity by the alkoxide or solution method. Under the circumstances, new merits of the oxide type are being discovered. At this year's fair, some companies presented mullite sintered bodies.

Turbo charger rotors made of silicon nitride and locker arm chips of high-strength, high-toughness zirconia were also on display, reflecting the rapid evolution of materials applications. Turbo charger rotors exhibited at previous fairs were all in an experimental phase, but those displayed this year by several companies are for practical use. Development of practical turbo charger rotors is due mainly to progress in technology joining ceramics and metals. This should be evaluated as a step toward a future ceramic engine.

Locker arm chips take advantage of the high toughness of partially stabilized zirconia. Other items, including cutlery, anti-abrasion materials, machine parts, and flexible ceramics were exhibited by many participating companies. The wide range of applications of partially stabilized zirconia promises further development in the future.

Concerning molding methods, the injection molding method has advanced, and is attracting attention in recent engineering ceramics. The principle of this method is the same as that of the plastic molding method. Organic type additives, such as wax and thermoplastic resins are used.

As far as sintered bodies are concerned, (Green) density has a great influence on their density. Therefore, grain diameter distribution is controlled in order to enhance the grain concentration without impairing fluidity. This technology has also progressed.

Macromolecular-type binders have a problem with grease removal before sintering. Grease-removing kilns exclusively for ceramics were exhibited at the fair. Fully automatic CIP devices for molding have been developed and were exhibited at the fair.

There were only a small number of ceramics processing machines on display. Main items were ultrasonic processors and laser processors. Precision cutting machines and chevron notch cutting machines were also exhibited. Apart from these, electric discharge processing is a goal.

Regarding evaluation equipment, precision universal material testers for ceramics, pulverulent body characteristics evaluation equipment, non-destructive inspection devices, ultrasonic-system elasticity-measuring devices, high-frequency ultrasonic deep flaw devices, industrial thermography devices, simultaneous oxygen and nitrogen analysis devices, high-temperature heating test systems for fine ceramics, and impact test systems for fine ceramics were all displayed. Among these, non-destructive inspection devices have been improved.

Meanwhile, incorporation of conventional materials of functional ceramics have advanced further. Automobiles, ferrite induction unmanned carriers, robots with visual sensors, simple electronic blackboards, and ceramic speaker units were exhibited.

Other materials included high-quality ceramic condensers, humidity and dew condensation preperception sensors, flammable gas sensors, optical fiber

sensors, and niobic acid lithium, which supports new telecommunication technology. These afforded visitors a glimpse of future developments through functional designing.

Themes

Thematic exhibits were given for the purpose of introducing fine ceramics to the public, thus enlightening them and diffusing fine ceramics. This "zone" had three departments. The first department was "The ABC's of Fine Ceramics," the second department, "A View of Fine Ceramics Technology," and the third department, "Life Sciences and Fine Ceramics." In the third department, different themes are chosen each year.

The first department explained fine ceramics, the materials, the functions, and the characteristics in simple terms. Ultrahard, high-strength, heat-resistant, corrosion-resistant materials were exhibited as structural materials to show their various characteristics.

Interesting exhibits included polycrystal diamond sintered bodies with ultrahardness and high strength, hair clipper blades, saws, go-carts carrying heat-resistant and corrosion-resistant ceramic engines, turbo charger rotors, locker arm chips, and remote infrared heaters. The exhibits of functional materials included functions of insulation, electric conductivity, piezoelectricity, magnetism, fluorescence, translucence, and optical conductivity.

Some interesting items were thermal printers and ceramic batteries with electrically conductive functions, ultrasonic sewing machines and ultrathin ceramic speakers with piezoelectric functions, and photomask substrates with translucent functions. About 60 kinds of items, including those which had been exhibited at previous fairs, were on display.

The second department focused on single crystals, which are recently attracting renewed attention, and their production methods, coating, compounding and joining technologies, and materials using these technologies. In the single crystals corner, a pulling-up device was one example of production methods. The exhibits were artificial diamonds, artificial rubies, other gems, artificial crystallized quartz, silicon single crystals, GGG, GaAs, InP, and other related products.

In the coating corner, coating materials were displayed, and the PVD, CVD, and plasma methods were explained as coating technology. Cutting dips, watch cases, toothed wheels, jet engine turbine blades, and diamond coated speaker vibration boards were exhibited as products using this technology.

The compounding and joining corner had composite materials reinforced by SiC fibers or wiskers, and materials made of SiC and Al metals. Exhibits included automobile parts, golf club faces, ski boards, rackets, golf shoes, and piston heads. With regard to joining methods, the ceramics electric joining method, oxide joining agent method, surface separation joining method, ceramics explosive joining method, and non-pressurizing wax joining method were explained. As applications of this technology, turbo charger rotors,

color ceramics joining products, and nuclear reactor bulkheads were exhibited.

The third department aimed at illustrating the role of fine ceramics for human beings. Here, the relationship between mechatronics, biotechnology, and fine ceramics was explained. Bioceramics were on display.

Mechatronics-related exhibits were keyboard robots, two-footed walking robots, five-finger robot hands, measuring robots, and various sensors. Biotechnology-related exhibits included dental reinforcement materials, cosmetics, ceramic filters, thermography, and blood-protein detection equipment. Exhibited bioceramics were artificial tooth roots, artificial bones, artificial joints, artificial cardiac valves, and artificial blood vessels. The flexibility and the conformability of ceramics to human bodies have been improved year by year. In this context, further development of ceramics is expected.

20132/6091
CSO: 4306/3604

NEW MATERIALS

RECENT DEVELOPMENTS IN PLASTICS, METALS, CERAMICS REPORTED

Tokyo NIKKO MATERIALS in Japanese May 86 pp 24-30

[Text] Biopolymers Observed by Using Fluorescence Lifetime Measuring Units Connected to Personal Computer

Horiba, Ltd., has developed two kinds of popular type fluorescence lifetime measuring units, "NAES-500" and "NAES-550" which can be used to observe biopolymers such as cancer cells, by connecting with a personal computer. The main features of the two units are as follows: 1) These units can be used to analyze data by connecting with a personal computer; 2) the adoption of a multi-TVC (time voltage changer) in the units will enhance the photometric efficiency; 3) the use of a high-pressure gas sealing self-excited electric discharge lamp in the units will bring about high-luminance pulse; 4) in the case of the NAES-550, the measuring time can be shortened, because the fluorescence and the waveform of luminous sources can be measured simultaneously. These units are used to observe and study the biopolymers such as cancer cells, enzymes, etc., and to measure the impurities contained in semiconductors. The price of the NAES-500 is ¥7.4 million, and that of the NAES-550 is ¥8.5 million. The company will sell them through Nissei Sangyo Co., Ltd.

Clean Room Wear Corresponding to Class 1

Toray Industries, Inc., for the first time will supply clean room wear appropriate to class 1 clean rooms of the university research institute which will be completed at Tohoku district this spring. The new product is manufactured by mixing and weaving high-density textile and electrically-conductive fiber, "Luana" made by the company. Generally, fiber containing carbon excellent in corona discharge is used as an electrically-conductive string. This carbon will be fatal to silicon used frequently in electronic materials such as semiconductor substrate, etc. The Luana is regarded as an optimum material used for clean room wear for electronics, because the exfoliation and dropping of carbon can be prevented by passing carbon fiber through the core of Tetron long fiber. The company considers that it is possible to cope with the fabric and materials themselves by improving conventional high-density textile. The company has been working on the dustproof design for position and opening of fasteners. The company has also enhanced the dustproof effect by combining underclothes with each other. These underclothes are manufactured by weaving Luana and nylon into one material.

Film With a Thickness of less Than 50 μ, Manufactured by Using Aromatic Polyester Base Engineering Plastics

Unitika, Ltd., has developed a thin film sheet of less than 50 μ by using aromatic polyester base engineering plastics excellent in heat and flame resistances. The company has started selling it by the brand name of Emblate. Also, the company has increased the demand for the U-Polymer used mainly in injection moldings since it developed the new product in 1975. The U-Polymer is a transparent engineering plastic, and is excellent in heat, flame, and impact resistance. The market for the film sheet has been barely cultivated. In addition, the company has obtained the "UL-94VTM-0" which shows the highest flame resistance of thin film sheets with a thickness of 50-100 μ. This UL-94VTM-0 is stipulated by the UL (Underwriters' Laboratory) in the United States. Therefore, the company has started providing film sheets with a thickness of 15 μ to 5 mm and selling them on a full scale. The main features of these thin film sheets are as follows: 1) they are nonflammable because the critical oxygen index is 35; 2) they will not be deformed even if they are heated to a temperature of about 200°C; 3) the thermal shrinkage rate is less than 0.05 percent at a temperature of 150°C; 4) they are excellent in weather and radiation resistance. These thin film sheets are used in electronic parts, electrical and heat insulating materials, etc.

Peeling Strength of Six Kinds of Epoxy Base Adhesives Is Enhanced Sharply

Konishi Co., Ltd., has developed six kinds of epoxy base adhesives, "Bond Functional Epoxy Series," and has started selling them. These six kinds of epoxy base adhesives are classified into high-strength and structure type, low-temperature curing type, cryogenic resistance type, etc. The importance of the epoxy base adhesive as a functional adhesive has been emphasized increasingly, because it is excellent in durability and resistances to chemicals, water, weather, and heat. Conventional epoxy base adhesives have a weak point concerning peeling strength and low-temperature curing properties. But, the high-peeling strength and low-temperature curing properties have been given in the new series while making the best of the above excellent points. The new series is available in one-can heat hardening type and two-part cold curing type. The former type is also available in Bond E40, Bond E30, etc. The Bond E40 has high strength. That is, its tensile shear adhesive strength is more than 400 kg (up to now 300 kg is the most that has been available) per square cm, and its peeling adhesion is more than 18 kg (up to now only 1 kg has been available) per 25 mm width. The Bond E30 can be heated and hardened at a low temperature of 80°C. The latter type is also available in Bond E375, Bond E50L, etc. The Bond E375 shows its table strength even in very cold atmosphere and in liquefied gas. The Bond E50L has excellent durability against solvents such as gasoline, ethanol, etc.

Polycarboxylic Acid Base Ready-Mixed Concrete Water-Reducing Admixture

Nippon Zeon Co., Ltd., has developed a polycarboxylic acid base ready-mixed concrete water-reducing admixture, "M-10," and has started selling it to the ready-mixed concrete industry on a full scale. The M-10 is manufactured by using components extracted from C_5 fraction as raw materials. The ready-mixed

concrete has the following problem. If too much water is added to ready-mixed concrete, the concrete will shrink during drying, and will be liable to cracking. Usually, a water-reducing admixture is used to reduce the amount of water. However, in June 1986 the AIJ (Architectural Institute of Japan) revised the JASS5 (concrete work standard specification) so good-quality concrete can be manufactured. As a result, it is anticipated that the amount of water used to mix concrete for manufacturing ready-mixed will be stipulated to less than 185 kg per cubic meter of ready-mixed concrete. It is also anticipated that it will be difficult to cope with this stipulation by using a conventional water-reducing admixture with a water-reducing rate of about 12 percent. The features of the M-10 are as follows: 1) the water-reducing rate of a maximum of about 20 percent can be obtained by using the M-10 together with a conventional water-reducing admixture; 2) the M-10 is economical, because the amount of cement used in the ready-mixed concrete work can be reduced; 3) the M-10 has the flow holding time equivalent to that of usual and standard ready-mixed concrete. The selling price is ¥400 per kg.

Transparent Conductive Film Is Mass-Produced on Base of PES Film

Sumitomo Bakelite Co., Ltd., has established a system for mass producing transparent conductive films, and has started extending a sale of these films. Such films have already been manufactured on an experimental basis and sold since 1983. The company invested about ¥1 billion in the Amagasaki Plant of the company with a view to constructing a new production facility. The new production facility was completed in November 1985, and started producing such films in January of this year. The annual production capacity is 100,000 square meters. The transparent conductive film is manufactured by forming an ITO (indium-tin oxide) film on the base of a PES (polyethersulphone) film. This manufacturing work employs a sputtering method. It is expected that this new film will be used in the fields of touch panels and electrode substrates for liquid crystal displaying elements. The features of the new film are as follows: 1) the film quality is uniform; 2) the new film possesses optical features equivalent to those of glass substrates; 3) the new film is excellent in heat and solvent resistances; 4) the bond strength with substrate films is high. The selling price is ¥15,000-¥30,000 per square meter.

Non-Halogen Type Flame-Retardant Polyethylene Molding Material for Communication Cable

Sumitomo Bakelite Co., Ltd., has a non-halogen type flame-retardant polyethylene molding material, "Sumikon RM-E1550," and has started selling it. This new material does not contain any compound based on halogen, and is used in sheaths for communication cables. Materials containing compounds based on halogen have been used up to now as sheaths of electric wires. But in the case of a fire, such materials have the problem of generating poisonous gas. The above new material has stood group cable vertical combustion tests conducted in accordance with the IEEE (Institute of Electrical and Electronics Engineers)-383 stipulated in the United States. This new material possesses the following features: 1) the amount of smoke generated during combustion is small; 2) the flame spread preventing effect is high, because cinders are hard; 3) the new material has excellent wear qualities and bending resistances;

4) the work of laying communication cables, electric wires, etc., can be carried out readily, because the new material is very flexible. The company is planning to extend the use of such new material in the fields of electric power cables and ship cables other than communication cables. The price is ¥900 per kg.

Large Coating-Drying Oven Employing City Gas

Working Time Is One-Twentieth of Conventional Time

Osaka Gas Co., Ltd., has developed a large coating-drying oven, "PCM (Pulse Code Modulation) High-Speed Infrared Coating-Drying Oven" employing city gas. A forming and assembling precoat system is mainly being used after sheathing materials are coated because the efficiency can be enhanced easily, the model can be readily changed, and multiple colors can be used in the production line for bulky goods such as washing machines, etc. It is necessary to enhance the economic efficiency of coating-drying ovens used in this system. The above new coating-drying oven employs city gas, and is a unit based on the combination of infrared rays and far infrared rays. Ceramic fibers are used in a unit heater which generates these rays, and an infrared burner is used to heat these ceramic fibers. The surface temperature of this infrared burner can be arranged stably. The inside of the new oven consists of infrared rays, far-infrared rays, and heat insulating zone. It is devised so that the waste heat of the new oven is reused to dewater and dry the coating pretreatment process. The length of the new oven (Unit 1) is 8 meters. High efficiencies have been obtained as actual operating results. For example, the drying time is one-twentieth that of hot-air drying ovens with the same capacity as that of Unit 1. Both fuel consumption per unit product and installation space are about one-third those of these hot-air drying ovens. The productivity per unit area is 4.5 times that of the hot-air drying ovens.

Continuous Thinning of High-Polymeric Films Based on Silicon at a Thickness of 0.1 μ or Less

Matsushita Electric Industrial Co., Ltd., has established a technology for continuously ultrathinning high-polymeric films based on silicon to the thickness of 0.1 μ or less. The company will commercialize such films as oxygen enrichment membrane units at high-flow rate by using this technology. Usually, the use of oxygen cylinders, liquid oxygen, zeolite adsorption, etc., can be cited as methods of enriching the oxygen concentration. But, these usual methods have disadvantages of size and economic efficiency. The oxygen enrichment membrane developed new by the company, is manufactured by attaching an ultrathin separation film based on silicon to a porous supporting film made of polypropylene. This ultrathin separation film has a thickness of 0.1 μ and a crosslinkable molecular structure, and is excellent in oxygen selectivity and mechanical strength. Therefore, it is possible to continuously produce thin high-polymeric films by using the LB (Langmuir-Blodget) method. The concentration of 21 percent of oxygen contained usually in air can be enriched stably to 30 percent at high-flow rate. In addition, the initial facility cost can be recovered in 1½ to 2 years by using city gas fuel. Also, the rate of energy conservation in glass solution, cupola, and forging hot

oven is 25-30 percent. When the company commercializes high-polymeric films used to combust gas, it will study the introduction of system equipment in collaboration with Osaka Gas Engineering Co., Ltd. On the other hand, Nippon Oil Co., Ltd., is conducting research on use of high-polymeric films used to combust petroleum. Also, Matsushita Electric Industrial Co., Ltd., is planning to immediately conduct research on use of high-polymeric films used to concentrate methane, because high-polymeric films which are main elements are excellent in separability of methane and carbon dioxide as well as that of oxygen and nitrogen.

Use of Technology for Modifying Surface of Fine Powder Brings About Manufacturing of Functional Composite Materials

Nara Machinery Co., Ltd., has developed a technology for modifying the surface of fine powder under the guidance of Masumi Koishi, professor at department of pharmacy of Science University of Tokyo. In order to modify the surface of fine powder, first child particles are adhered to parent particles of powder which will become a core. When large and small powders put at an appropriate rate in a mixing granulator are mixed with these particles in the mixing granulator while dispersing the large and small powders, child particles adhere to the surface of parent particles by the force of static electricity generated by electrifying friction. These child particles are moved, placed, and fixed on a hybridizer developed independently by the company. The hybridizer is a machine with the same structure as that of a dry grinding machine equipped with 6 to 24 rotating impeller blades. The number of rotating impeller blades depends on the amount of treatment of such particles. These blades rotate at a low speed of 300 to 15,000 revolutions per minute. It is said that powder of parent particles to which child particles adhere will undergo small force which cannot pulverize the powder and will be fixed steadily in 2 minutes. The size of parent particles of applicable powder is 100 to 0.1 μ, and that of child particles of such powder is 10 to 0.01 μ. The company has already developed a new material for cosmetic. The color developing property of the new material has been modified by joining titanium dioxide to nylon resin and concealing parent particles. In addition, the company has succeeded in performing experiments in which parent particles are coated uniformly by melting down child particles with heat generated when the powder is fixed. The new powder is used to conceal the substances, to control the slow-dischargeability, to enhance the electric and magnetic characteristics, to improve the capillary active effect, to give the mechanochemical effect, and to improve the taste. It is expected that the use of such new powder will spread to the fields of pharmaceuticals, ink, powder metallurgy, etc.

Import and Selling of Steel Fiber for Reinforcing Concrete

Bridgestone Corp. will start selling the steel fiber for reinforcing concrete on a full scale by the brand name of "Dramix." The Dramix is made by Bekaert Co., Ltd., in Belgium. Concrete is a material which has been used for a long period of time in the fields of civil and architectural engineerings, but it has a disadvantage whereby it is liable to be easily broken or cracked, because it will shrink when it is dried. At present, steel, glass, carbon fibers, etc., are used as reinforcing materials to overcome this fault. The Dramix

possesses the following features: 1) it can be used only by directly putting and stirring it in a ready-mixed concrete mixer; 2) it is excellent in dispersibility and the uniform mixture can be obtained, because fibers are mutually jointed with a water-soluble adhesive; 3) the fixed function is strong, because it has a hook shape; 4) the mixing rate is lowered sharply. The Dramix is used for industrial floor slabs, concrete pavements, etc. The price is ¥300 to 400 per kg. Also, the Dramix will be imported by Bridgestone Bekaert Steel Cord Co., Ltd., which is a corporation managed jointly by Bridgestone Corp. and Bekaert Co., Ltd.

Four Steel Companies Conduct Research on Rise in Working Methods and Performance With the Aim of Extending the Use of Superplastic Metal

Four steel companies, NKK (Nippon Kokan K.K.), Sumitomo Metal Industries, Ltd., Kobe Steel, Ltd., and Daido Steel Co., Ltd., have started conducting research on improving working methods and performance with the aim of extending the use of superplastic metal, "Titanium·6 Aluminum·4 Vanadium" which is lightweight and is excellent in high-heat resistance. This metal has two phases called "Alpha" and "Beta" in its alloy structure, and the shift between the two phases is large at high temperatures. This fact shows the superplasticity. Although the new metal is an alloy of titanium and aluminum which are hard to work, it is said to be possible to work this new material. For this reason, it has widely been used in the frame material of aircraft, mainly in the United States and Europe. Each company is enthusiastically conducting basic research on analysis of crystalline state, mechanical strength, and physical transformation of this new alloy according to use of additives. This basic research includes important points for extending the use of the new alloy such as change of temperature regions which show superplastic states, rise in yield during work, improvement of working methods, etc. In many cases, trial-working materials which have been published up to now, are used for expensive members such as plate materials for aircraft, materials which constitute inside and outside of airframe, etc. Sumitomo Metal Industries, Ltd., and Kobe Steel, Ltd., are conducting research on improvement of performance, arrangement of working temperature regions, addition of the fourth element such as yttrium, etc. NKK is directing its energies to research on rolling of thick plates. Daido Steel Co., Ltd., is concentrating on research on mechanical workability, melting of scraps, etc.

Aluminum Foam Is Used for Heat-Transfer Improving Materials, Catalytic Carriers, Etc.

Chuo Denki Kogyo Co., Ltd., has developed an air-permeable aluminum foam, and has started shipping its samples. This foam is a new material with a framework of the three-dimensional net similar to spongy parenchyma. It is manufactured by pouring molten aluminum into a sponge based on polyurethane in molding materials and taking out these molding materials with a special agent. The number of cells is 6 to 13 per inch. The apparent density is 0.05 grams per cubic cm. The porosity is 88 percent, which is much higher than that (60-70 percent) of sintered filters. The new foam is lightweight, and is excellent in air permeability and heat transferability, because it is made of aluminum. Therefore, the company expects that this foam will be used in the heat transfer improving

materials of air conditioners, catalytic carriers, soundproof materials, sound absorbing materials, vibration insulators, mixing machines, etc., as well as structural materials in the aircraft and space fields. The company is planning to commercialize this product 2 years later on a full scale. At present, the largest product measures 100 x 100 x 150 mm. The price is about ¥10 million per cubic meter. Although the product is expensive, when it is mass-produced, the price will be lowered to less than ¥1 million.

Hermetic Type Energy Conservation Heat Pump Reduces Heat Source Electric Power Cost by 21 Percent

The Kansai Electric Power Co., Inc., has developed a hermetic type heat storage pump which will bring about sharp energy conservation as compared with conventional heat pumps. Heat storage pumps are used by employing midnight electric power as one of the air conditioning heat source energies of office buildings, etc. Open piping heat pumps which have been used up to now, require large pumping power, because the interval between roof heat source and underground heat storage tanks must directly be circulated. Also, these conventional pumps have a problem of corrosion of piping systems, etc. The above new pump is designed so both circuits of heat source and underground heat storage tanks are closed and separated from each other. There is no need to lift water up to the roof heat source by connecting the interval between water and water and heat exchanger, and the pump power is lowered. It is also designed so the resistance loss is reduced by arranging water piping systems of heat source and air-conditioners in series and by shortening the piping length. Therefore, it can be expected that corrosion resistance will be enhanced, because no air enters into the heat source and load piping systems. The company has adopted such new pumps in new buildings of relevant companies, and has collected data on these new pumps. As a result, it has been found that the construction cost is 2 percent lower than that of buildings employing conventional type pumps, i.e., open type heat storage pumps, and the heat source electric power is 21 percent lower than that of these buildings. Therefore, the company expects that this new pump will be able to sufficiently compete with the heat storage heat pump employing city gas as a heat source.

Ultrahigh-Purity Metallic Niobium Is Used in IC's, Superconductive Thin Films, Etc.

Toyo Soda Manufacturing Co., Ltd., has developed an ultrahigh-purity metallic niobium with a purity of more than 99.999 percent, and has started shipping its samples. Niobium is refined from (pychlore) mineral, and is used presently in the external cylinder of engine combustion chambers, structural materials of nuclear reactors, etc., because it is excellent in heat resistance and thermal conductivity. However, the highest purity of niobium on the market was 99.99 percent, because it was difficult to separate the impurities such as oxygen, nitrogen, etc., and various metals such as tantalum, etc., from niobium. The company has succeeded in obtaining the high-purity niobium by using the following method. That is, niobium and a halogen compound are reacted with each other in a vacuum unit, impurities such as tantalum, iron, etc., are removed by refining this halogen compound, and the halogen compound is removed by carrying out the pyrolysis. Niobium obtained by using the above method has a concentration of tantalum of less than 10 parts per million. This figure is much lower

than the highest figure (150 parts per million) of niobium on the market. This new niobium has a concentration of metallic impurities of less than 1 part per million in most cases. This figure is one-fourth that of conventional niobium. In addition, the concentration of gas components such as O (oxygen), C (carbon), N (nitrogen), H (hydrogen), etc., contained in the new niobium is lowered to about 10 parts per million. It is expected that the new niobium will be used in the IC's (integrated circuits), superconductive thin films, high-frequency acceleration cavities of accelerators, etc. The price is ¥20,000-30,000 per gram.

Fiber Based on Zirconia Is Used in FRM, Insulator, Etc.

Shinagawa Refractories Co., Ltd., has developed a zirconic ceramic fiber, and has started selling it on a full scale. Zirconia has the highest melting point of 3,700°C, and is an inorganic material excellent in chemical corrosion resistance, strength, and durability. In addition, it is hardly evaporated at high temperatures. In order to manufacture the zirconic ceramic fiber, first the solution of the zirconia compound is thinned just like a string, and the thinned solution is burned at a high temperature of 1,000-1,300°C. Conventional zirconia fibers are produced only by Zircar Co., Ltd., in the United States. The length of these zirconia fibers was 5 mm. The zirconic ceramic fiber has an average length of 20-30 mm and an average diameter of 5 μ. The new fiber is white and cottony. It can be produced without any stabilizer at normal temperatures in a series of manufacturing processes. It is available in five kinds, i.e., zirconic ceramic fiber employing 100 percent zirconia, that employing a stabilizer and magnesia, that containing 4 to 7 percent yttria, that containing 4 to 7 percent lime (calcium oxide), and that formed just like a board. Bulk fibers are used to reinforce the enameled products, and are used in FRM (fiber-reinforced metal) and FRC (fiber-reinforced ceramics). Also, mat board type fibers are used in various heat insulating materials of industrial furnaces, insulators, etc. The price is less than ¥40,000 per kg, which is lower than that of the imported fibers. The company has completed a plant with a monthly production capacity of 1 ton in the Okayama Factory and has started producing such new fibers.

Short Carbon Fiber Based on Coal Pitch

Osaka Gas Co., Ltd., Dainippon Ink & Chemicals, Inc., and Nippon Steel Glass Co., Ltd., have jointly developed a general-purpose carbon fiber which is a short fiber based on coal pitch as a raw material. These manufacturers will ship samples in the near future. This general-purpose carbon fiber is manufactured by using a coal pitch processing technology belonging to Osaka Gas Co., Ltd., a polymer-chemical technology belonging to Dainippon Ink & Chemicals, Inc., and a vortex method as a glass short fiber manufacturing technology belonging to Nippon Steel Glass Co., Ltd. It is said that the general-purpose carbon fiber is excellent in quality and cost as compared with short carbon fiber based on conventional coal pitch, manufactured by using a centrifugal method. The three companies have already completed a semicommercial plant with an annual production capacity of 10 tons, and will establish a manufacturing subsidiary company in 1987. This company will start commercializing the new fiber in the same year. The three companies expect that the new fiber will

be used in the cement reinforcing material, electromagnetic shield material, high-temperature heat insulating material, etc. These companies also estimate that if the new fiber is mass-produced, the cost will be reduced by 20-30 percent that of existing products.

Continuously-Automatic Production Commercializes Silicon Carbide Whiskers

Nikkei Techno Research Co., Ltd., which is a research institute affiliated to the Nippon Light Metal Group has independently established a technology for manufacturing SiC (silicon carbide) whiskers, and will start shipping their samples in the near future. The most important feature of this technology is the complete continuous automation from raw material mixing work to transportation, reaction, and product dealing work. The company has already operated a pilot plant with a monthly production capacity of 150 kg. SiC whiskers are used as reinforcements of composite materials such as FRM, FRP (fiber-reinforced plastics), SiC whisker reinforced aluminum, etc. These SiC whiskers have come into the limelight as new mechanical structural materials or automobile structural materials, because it is considered that they can be combined with ceramics. Also, the company has succeeded in manufacturing a long SiC whisker with a length of 200 mm on an experimental basis. Although this long SiC whisker has many problems until it is industrialized, the company is planning to rapidly improve its technology, because there is a strong possibility of the long SiC whisker being used as a functional material in the field of electronics.

Ceramic Artificial Bone Filling Material Based on Apatite Enhances Biological Adaptability

TDK Corp. has developed a ceramic artificial bone filling material based on hydroxyapatite. The company will make an application for approval for manufacturing this new material to the Ministry of Health and Welfare, and will commercialize it during this summer. A part of the ceramics has been put to practical use as an artificial bone, because ceramics are lighter than metal, are resistant to acid and alkali, and are excellent in biological affinity. These ceramics are classified into two kinds. One is based on alumina, and the other is based on apatite. The former is resistant to pressure, but is slightly inferior to the latter in respect of biological affinity. On the contrary, the latter is not resistant to pressure, but is excellent in biological affinity, because it has the same quality as that of main components of natural teeth. The above material developed by TDK Corp. is a porous granular ceramic based on apatite. It can be used as a filling material of bones and artificial otosteons, because it is excellent in adaptability with cells and pressure resistance. Its hole diameter is 20-50 μ, larger than conventional. At present, Tokyo Dental College and Keio University are conducting clinical demonstrations concerning the new filling material. As soon as TDK Corp. obtains approval for the new filling material from the Ministry of Health and Welfare, the company will start promoting the sales of the new filling material through a trading company related to dental materials. TDK Corp. plans to trade name this new material "Bioact."

Plastic Deformation of Alumina-Based Ceramics Opens Way for Manufacturing Complex Products

Toshiba Tungaloy Co., Ltd., has developed a technology for manufacturing products such as flat spring, etc., by plastically deforming aluminum-based ceramics to which titanium carbide is added. It was expected that these alumina-based ceramics would be used for cutting tools, wear-resistant parts, etc., because they are excellent in high-wear resistance and high-temperature strength up to around 1,000°C. However, one disadvantage is that it is difficult to plastically deform them, because they are complex products. Therefore, the company has opened the way for manufacturing such complex products by using the special plastic deformability possessedby raw materials and by minutely controlling the temperature and pressure. For the time being, the company intends to use the above new technology in the cutting tools, pump impellers, etc., as well as flat springs, spring washers, etc.

20143/9365
CSO: 4306/3601

HIGH-PERFORMANCE CERAMIC FILM DISCUSSED

Tokyo NIKKO MATERIALS in Japanese Jun 86 pp 38-41

[Article by M. Ono, assistant director of Ceramics Laboratory, Mitsubishi Mining & Cement Co., Ltd.]

[Text] 1. Introduction

Over the last several years, ceramics have been recognized as a new material and have been given wide coverage, even by general newspapers and journals. Recently, not only ceramics manufacturers whose major products are ceramic ware, glass, refractories, and cement, but also companies from other industries are participating in this field, further intensifying developmental competition for new technologies and products. Following the introduction of ideas and procedures from different fields, and along with increasingly diversified and sophisticated needs, ceramic technologies have remarkably expanded and are serving as a driving force promoting development of new products and practical applications.

The major reason for all this attention is that ceramics have outstanding electric, mechanical and chemical properties, in addition to their inherent characteristics of heat resistance and durability. Another feature of ceramics is their diversity. Ceramics have a potential yet to be identified. In fact, new high-performance ceramic products are being developed one after another and will play an essential role in the progress of high technologies.

Ceramic products are basically made up of polycrystals and it would not be wrong to say that their characteristics depend on their chemical and mineral compositions and microstructures. In other words, in order to have the ceramics exhibit their potential properties, control of their fine tissue and structure is important. The difference between the theoretical value and experimental value for material properties, which is estimated to be on the order of more than 10 times with metals, is said to be as large as several hundred times with ceramics. This is mainly attributable to the microstructure of ceramics, particularly the grain boundary. The uneven size of crystals, presence of voids, or generation of a secondary phase due to the uneven quality of the raw material, among other things, are causes for deterioration of the characteristics of ceramics. In order to control the

microstructure of ceramics and present products without structural defects, it is imperative to establish new technologies, in particular, a process by which raw materials in physical, chemical and metallic qualities can be prepared. The establishment of such technology would make it possible to realize the "high-performance ceramics" currently demanded.

Based on this, and for the purpose of meeting demand for better performance of functional ceramics, especially those used in microelectronics, we have been working on a method of preparing even, fine raw materials, and developing new ceramic manufacturing processes which capitalize on the characteristics of these raw materials. As a result, we succeeded in preparing raw materials of superfine particles using metal alkoxide as the starting substance, and in establishing a new technology to produce ceramic products in the form of a thin layer sheet. This article will outline the new production process and alumina thin layer ceramic substrate produced by the process.

2. Outline of the New Production Process

The most effective method to maintain and reproduce evenness in terms of particle size, particle size distribution, shape and composition of the raw material, is chemical synthesis of fine or superfine particles, using a liquid phase process. The liquid phase process, where a fine and even solid phase is formed through solution reaction, features:

(1) Easily obtained even composition of multiple ingredients;

(2) Ability to control particle properties, i.e., particle size, distribution, and shape, and ability to diversify by utilizing various solution reactions;

(3) Outstanding characteristics for mass production; industrialization is possible in terms of costs.

On the other hand, the use of powder materials has been identified as a factor that makes the control of ceramic microstructures difficult, and hampers high functionability. There are a number of problems in dealing with industrial processing of powder materials. To specify and control their properties is not easy. In particular, when it comes to superfine particles with their remarkably enlarged surface activity, it is almost impossible to process them in the dry state without causing pollution on the particle surface, and coagulation.

In light of such facts, we have decided to develop a new technology which does not use powder raw materials and would drastically change the conventional technological concept, and to develop highly reliable products to meet needs in high-technology areas, including the rapidly growing microelectronics field. In order to avoid surface pollution and coagulation of fine or superfine particles formed by the liquid phase method, and to utilize particles in a sufficiently dispersed condition, we have developed a type of sol-gel process where particles suspended in the liquid phase are made into sol, which in turn is dried into a certain form. Thus, we could

obtain a new ceramic manufacturing process which does not use powder. Another advantage of this technology is that dealing with liquid material makes it possible to integrate a series of processes, from the synthesis of raw material particles to the production of green sheets in one operation.

Among the various conceivable procedures to prepare superfine particles by the liquid phase method, the most promising is the hydrolysis of metal alkoxide. The alkoxide method features:

(1) Most of the metal elements considered for ceramics can form alkoxide, resulting in a diversity of products.

(2) The refining process eliminating impurities by petrochemical procedures can be employed to achieve high purity levels.

(3) Alkoxide hydrolysis is very fast with a small difference among different elements. Therefore, the desired combination of ingredients can be realized at a level of particle units.

(4) Involved in the reaction system are, except the sedimentation generated, water, alcohol, organic solvents, etc.--substances which can be removed through physicochemical processing. The generated superfine particles can be easily made into sol without soiling their surface.

Chart 1 [not reproduced] shows the flow of the new process manufacturing dense and even quality alumina substrate of 30-100 μm in thickness, which is needed in the field of microelectronics. The process is integrated from the synthesis of aluminum isopropoxide to production of dry green sheets, and is controlled by one person using a computer.

3. Characteristics of Alumina Film

The minimum thickness of the alumina substrate which can be manufactured by the conventional method using conventional materials, as done by the Brade method, is about 200 μm. On the other hand, our new technology makes it possible to produce thin-layer products on the order of less than 100 μm, down to approximately 30 μm. From starting material of superfine particles prepared by the alkoxide method, our substrates have a dense and even microstructure with internal structure deficiencies far smaller than conventional products. These substrates are also outstanding in surface smoothness. Even without being polished, their smoothness level approaches that of conventional polished products. Chart 2 [not reproduced] shows some of the alumina films made by the new process. The mechanical and electrical properties of the new alumina film, in contrast to the values of conventional substrate, are shown in Tables 1 and 2 [not reproduced].

The mechanical strength of alumina film indicated in Table 1 refers to the value obtained on a 30 x 10 mm sample piece by the three point bending method with a span of 20 mm. The heat conductivity value is calculated by converting the heat dispersion rate measured by the AC method at 25°C and 8 Hz, using the actually measured density and setting specific heat as 0.19 (cal/g·deg).

Dielectric constant and dielectric loss in Table 2 represent values measured at 25°C and 1 MHz, the volume specific resistance is valued at 50 V for 1 minute.

As shown in Tables 1 and 2 alumina film with a dense and even microstructure exhibits remarkably improved properties when compared with conventional substrate. Its characteristics are particularly conspicuous in bending strength and insulation resistance pressure.

4. Applications of Alumina Film

As stated in the previous section, alumina film has outstanding surface smoothness, electric insulation and heat conductivity as well as mechanical strength sufficient for handling. The film can be used in various fields where devices, such as substrates for hybrid IC's and for various types of sensors, are required to be smaller and lighter. Other conceivable applications include multilayer wiring substrate for more intensive wiring. For thick membrane printing substrate, 96-97 percent alumina film is produced taking into account adhesiveness in the glazing process. For thin membrane use, film with a purity as high as 99-99.9 percent is available.

In addition to such applications, film will also be used in microwave circuits--a field which is expected to grow rapidly. In the microwave zone (1-300 GHz), electromagnetic wavelength is on the same order as that of ordinary conductor circuits and electronic devices, making general electronic circuits unable to function as transmission routes. In the microwave circuit where electromagnetic waves are distributed spacewise, the coaxial line and waveguide have been used conventionally. Recently, use of the strip line having been rapidly diffused to reduce size, enhance reliability and lower costs, practical applications are said to have progressed up to 15 GHz, while technical accomplishments are up to 30 GHz.

The strip line, a deformed model parallel flat waveguide, is made up by mounting the contact conductor and strip conductor on a dialectic substrate made of alumina, etc., as shown in Chart 3 [not reproduced]. An electric field is added between the two conductors to transmit electromagnetic waves in the dielectric substrate according to the distribution constant. When a dielectric substrate whose dielectric constant is about 10, such as alumina, is used, and the property impedance of the strip line is set at 50, the ratio of the width of the strip line, W, against the thickness of the dielectric substrate, h, must be 1. The width of the strip line being around 80 μm in the recent microwave integrated circuit, alumina film of 80 μm in thickness is an appropriate size. Important properties required for the microwave integrated circuit substrate include surface smoothness, thickness accuracy, certain values for dielectric constant and dielectric loss and their accuracy. Alumina film is the most suitable material satisfying all these requirements.

Beside the above, another special application of alumina film is its use as speaker vibrators. Because of its dense microstructure, the vibrator made up with alumina film shows properties of sound speed 9.4 (km/sec) and Young's

modulus 3.4 x 10^{11}(Pa)--performances compatible with alumina monocrystals--which make it possible to expand widely the resonance frequency to achieve acoustic properties of wide frequency range, low distortion, and wide dynamic range.

5. Conclusion

The author has briefly introduced alumina film--high-performance thin-layer alumina film produced by innovative ceramic production technology--discussing its production process, characteristics and applications. The new production technology employs generally applicable procedures which can be used for production of not only alumina products but also various ceramic goods such as zirconia, making application use of the technology very broad. Also, with this technology we can provide finished goods with functions that make the goods usable not only in the electronics field but also in many other areas.

In order for the products to fully exhibit characteristics of fine or super-fine particles, however, the process needs further improvement. We will endeavor to promote technical development to produce a group of products in demand in the high technology field so that we can meet the increasingly diversified and sophisticated need for ceramics.

20126/6091
CSO: 4306/3606

NUCLEAR DEVELOPMENT

PLUTONIUM UTILIZATION PLAN DISCLOSED

Tokyo GENSHIRYOKU SANGYO SHIMBUN in Japanese 5 Jun 86 pp 1, 6

[Article by editor: "Concrete Plans for Utilization of Plutonium in Light-Water Reactors; Full-Fledged Utilization of 12 Reactors From 1997 Planned"]

[Text] On 4 June 1986, MITI convened a meeting of the Subcommittee on Nuclear Power, Advisory Committee for Energy, and presented a report titled "Plutonium Utilization Plans for the Future." The report, which takes into account updated information on concrete progress of plans for siting three nuclear fuel recycling facilities on Shimokita Peninsula, has revealed the nation's basic strategy for plutonium recycling. In the report, the subcommittee has reaffirmed its basic policy "to utilize plutonium in high-speed breeder reactors, but in the interim, before the technology is put to practical use, the fuel will be used in light-water reactors and advanced thermal reactors." It continues, "after running prototypal tests using a practical use level reactor in the 1992-94 period, plutonium will begin to be used, on a full-fledged basis, in a total of 12 reactors from around 1997."

As for sources of plutonium for Japan, shipments of plutonium produced as a by-product of reprocessing spent nuclear fuel, which work that Japan has commissioned foreign countries to do, are scheduled to start arriving in Japan from about 1990. With progress in the nuclear fuel recycling program on Shimokita Peninsula, shipments are also expected to start arriving there from private reprocessing plants around 1995.

Faced with plutonium supply plans which are beginning to take on a concrete shape, MITI has been making studies on Japan's strategy for plutonium utilization in a subcommittee on plutonium recycling established within the Advisory Committee for Energy last August.

On the basic idea for plutonium utilization, the report again has emphasized the importance of early utilization of the resource by saying, "Utilizing plutonium, a by-product of nuclear fuel reprocessing, will not only contribute to conservation of uranium resources but it is desirable as well from the standpoint of nuclear nonproliferation." The report reaffirmed Japan's basic policy which is "to utilize plutonium in high-speed breeder reactors but, in the interim, before the technology is put to practical use, sometime around 2020, the fuel will be used in light-water reactors and advanced thermal reactors."

In connection with plutonium's utilization in light-water reactors, the focus of the plutonium utilization, the report puts forth a policy that reads, "The pluthermal (plutonium utilization in light-water reactors) is to go through three demonstration steps: a small number of fuel assemblies, a practical-use demonstration stage, and a full-fledged utilization stage. In the practical-use demonstration stage, plutonium utilization is to be started in one-fourth of a reactor core, in about 1992 for BWR and about 1994 for PWR." The report goes on, "In the full-fledged utilization stage, plutonium utilization is to be started in one-third of a reactor core from around 1997, in about six each of the PWR and BWR reactors."

As for the 12 reactors slated for plutonium utilization in the full-fledged utilization stage, the number was determined based on the plutonium balance. That is, the total plutonium supplies from the private reprocessing plant, plutonium supplies sent back to Japan from overseas fuel reprocessing plants, and plutonium supplies from the Tokai Reprocessing Plant minus the plutonium needed for the FBR and ATR projects.

The report states, "About 47 tons of MOX fuel will be needed during the practical-use demonstration stage, and in the stage when plutonium is put to practical use, about 1 million tons of MOX fuel will be needed annually from around 1995."

Referring to a setup for MOX processing, the report says, "For MOX fuel needed for the practical-use demonstration project, the Power Reactor and Nuclear Fuel Development Corporation (PNC), in cooperation with private companies, will start processing it from around 1990." The report further says that when plutonium has come to be utilized on a full-fledged basis, "the private sector will, as a rule, take the initiative in the production of mixed oxide (MOX), and the fabrication structure and facility site will be determined in the early 1990's."

In connection with nuclear nonproliferation, the report says that in order to promote utilization of plutonium, Japan "needs to sign and ratify the treaty for the protection of nuclear materials." As for sending back to Japan plutonium produced as a by-product of reprocessing spent nuclear fuel in foreign countries, the report says that "technical standards for air transport need to be established." As for the recovered uranium, the report says that "concrete studies need to be advanced."

Reserve for Reprocessing Untaxed; MITI Implements Policy in June

MITI has enforced a policy of making reserves that the electric power companies have been putting up as reprocessing costs tax-free effective 1 June 1986.

The reserve fund system has the objective of attaining an equal burden among generations. The electric power companies set aside future costs of reprocessing spent nuclear fuel at the time such fuel is generated. These companies have been putting up reserves, subject to taxation, since FY 1981.

On the strength of such achievements by the utilities, in March 1983 necessary ministerial ordinances were enforced, thus officially inaugurating the reserve fund system in the government. However, since there had never been revisions of the charges for electricity in the interim, the reserve system did not lead to any tax credit.

With the provisional reductions in electricity charges effective this month, which had been made possible by a drop in oil prices, a step has been taken to include reprocessing reserves in the cost of electricity. This gives rise to a streamlined power supply structure encompassing all aspects of charges, system and accounting.

The electric power industry has been setting aside about Y100 billion annually for reprocessing costs. The current tax credit is estimated at about Y50 billion in tax savings.

Plutonium Utilization Plans in Japan--by Nuclear Power Division, Advisory Committee for Energy

As reported, on 4 June 1981 the Nuclear Power Division, Advisory Committee for Energy, MITI announced a report titled "Plutonium Utilization Plans for the Future." With the implementation of concrete plans for the nuclear fuel cycle program as background, the report describes Japan's plutonium utilization strategy for the year 2010. Referring to plutonium's utilization in light-water reactors, the report particularly sets forth a policy which reads, "Plutonium utilization in light-water reactors should be promoted along three stages: operational testing using a small number of fuel assemblies, practical scale operational testing, and full-fledged operations. Full-fledged utilization of plutonium will begin around 1997 in a total of 12 reactors." The following outlines the report.

Full-Fledged Utilization of Plutonium in Light-Water Reactors To Start With Six Each of PWR and BWR Reactors

(Basic Idea)

Japan is relying on foreign countries for its entire needs for uranium resources. Utilizing plutonium produced during reprocessing spent nuclear fuel will not only save uranium resources, but it will mark effective utilization of plutonium as a kind of domestic energy resource. Thus, plutonium utilization is an important policy from the viewpoint of establishing national energy security.

As a leading user of nuclear power, for Japan to promote utilization of plutonium would not only help to raise the efficiency of utilizing uranium resources but would also contribute to stabilizing uranium prices.

Furthermore, utilizing plutonium, under proper controls, as a fuel for nuclear power generation is desirable from the point of view of nuclear nonproliferation.

(Utilization Policy)

Plutonium should be used in FBR's, the reactor that can most efficiently burn the resource.

However, practical use of FBR's in Japan is not expected until around 2020. From a viewpoint of establishing, as soon as possible, a structure for utilizing plutonium by the private sector, plutonium utilization in light-water reactors and advanced thermal reactors should be promoted until such time when FBR's reach practical application.

(Pluthermal Plan)

There do not seem to be any difficult technical problems with "pluthermal" (utilizing plutonium in light-water reactors). However, from the perspective of technical confirmation of the technology's characteristics, fabrication of mixed oxide (MOX) fuel, and accumulation of experience in handling the fuel, it seems advisable to promote the project as follows: demonstration reactor operation using a small number of MOX assemblies, practical-scale demonstration reactor operation, and full-fledged utilization.

1. Demonstration operation tests using a small number of MOX assemblies

With the objective of confirming the fuel's characteristics in light-water reactors, as well as accumulating experience in fabrication and handling of MOX fuel, a BWR and PWR are charged with a small number of MOX fuel assemblies.

Two MOX fuel assemblies for BWR have already been fabricated. Plans are under way for loading them in the Tsuruga No 1 reactor (357,000 KW) during fiscal 1986.

As for PWR, the four MOX fuel assemblies stored in the Mihama nuclear power plant compound are to be loaded in the plant's No 1 unit (340,000 KW). The project is to be advanced pending the understanding of the local population.

2. Practical-scale demonstration tests

With the objectives of confirming the characteristics of the reactor core when loaded with practical-use scale MOX fuel assemblies, as well as accumulating experience in handling and fabricating practical-use scale MOX fuel assemblies, a BWR and PWR are loaded with MOX fuel assemblies equivalent to about one-fourth the reactor core when fully loaded.

After considering the schedule for demonstration tests using a small number of MOX assemblies, the first loading of fuel will take place about 1992 for the BWR, and about 1994 for the PWR. The loading period consists of four cycles for the BWR and three cycles for the PWR.

Both the BWR and PWR are scheduled to have a capacity of more than 800,000-KW class. They are to be run jointly by the electric power companies.

3. Full-fledged utilization

When the time schedule for practical-scale demonstration tests is taken into account, full-scale utilization of plutonium in the BWR and PWR reactors ideally will start about 1997.

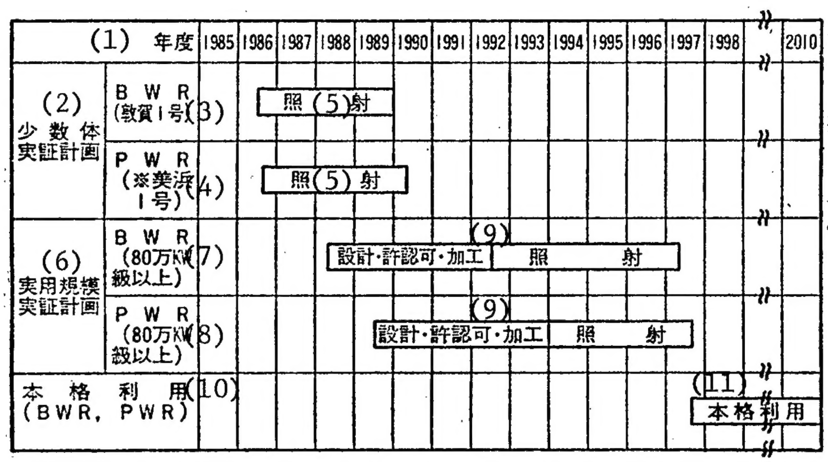
Consequently, given the lead times needed for obtaining government approval and/or permits, as well as for fuel fabrication, concrete plans need to be drafted to start the program by the early 1990's.

In the full-fledged utilization stage, the appropriate loading level of MOX fuel will be about one-third of the reactor core.

Judging from the plutonium balance until the year 2010, the pluthermal program will be carried out using about six each of the BWR and PWR reactors of the 1 million-KW class.

Full-fledged utilization of plutonium will have to be promoted by taking into account such factors as the plutonium balance, economics, and the progress of technical development at home and abroad.

Pluthermal Program



*Demonstration tests will begin only after obtaining the understanding of the local population.

Key:

1. Fiscal year
2. Demonstration tests using a small number of fuel assemblies
3. Tsuruga No 1 unit
4. Mihama No 1 unit
5. Irradiation
6. Practical-scale demonstration tests
7. Above 800,000-KW class
8. Above 800,000-KW class
9. Design, approval/permit, fabrication, irradiation
10. Full-fledged utilization
11. Full-fledged utilization

(Plans for Development of ATR and FBR)

Since FBR's are expected to become the mainstream reactors in the future in nuclear power generation, plans for the construction of a demonstration reactor should be steadily promoted, following successful development of the prototype reactor "Monju." For commercial use of FBR's, their cost performance needs to be raised, and to that end, technical development must be actively promoted.

ATR's can burn plutonium efficiently. Therefore, to establish plutonium utilization technology at an early stage, plans for construction of the demonstration reactor "Oma Atomic Power Plant" must be promoted.

Aiming at Establishing a Structure for Fuel Fabrication by the Private Sector; MOX Fuel Supply Structure

(MOX Fuel Fabrication)

1. Project for pluthermal practical demonstration tests

In order to prepare for full-fledged utilization of plutonium under the pluthermal program, during this period an effort will be made to accumulate MOX fuel fabrication expertise on the part of private manufacturers of the fuel.

To that end, the best way is for PNC and private nuclear fuel processors to cooperate and pool their resources in MOX fuel fabrication.

As for the cooperative setup between the two, the most desirable form will be a system where the existing fuel supply structure for light-water reactors is appropriately added to PNC's expertise in handling plutonium.

When such factors as the lead time needed for construction of a MOX fabrication plant, the need to secure the local population's acceptance of such a plant, and expertise in handling plutonium are taken into account, the most practical approach will be to take advantage of PNC's technology and equipment. It is appropriate, for now, to make the most of the Third Development Office's ATR line (40 tons MOX/year) for the ATR demonstration reactor.

As for the time schedule, assuming fabrication of fuel assemblies will have been completed a year prior to their loading, the setup for the project's implementation will have to be in place by about 1987 when the time required for the construction of processing facilities (2 to 3 years) and lead times for procedures for approval/permit and other matters are taken into account.

2. Pluthermal full-fledged utilization stage

Fabrication of MOX fuel, in principle, will be under the leadership of the private sector. However, studies will be needed among the concerned parties on the project's economics, etc.

The scale of MOX fuel fabrication will be only about 100 tons a year even when utilization of plutonium enters its full-fledged stage. Thus, even from the standpoint of cost, it is important for the private firms to coooperate, such as together building processing facilities for joint use.

Given the lead times necessary for improvement and construction of processing facilities, concrete plans will be needed by the early 1990's for the MOX fabrication structure and siting of processing facilities in the full-fledged pluthermal stage. Studies will have to be started as soon as possible on such items as economics, protection of nuclear matter, and public acceptance.

(Building an Environment for Plutonium Utilization)

1. Securing public acceptance

To ensure smooth progress of plutonium utilization, the most essential point is for the government and private sector to mount a concerted effort to gain the understanding of a broad spectrum of the population. This can be done by jointly mounting an aggressive publicity campaign emphasizing the meaning of plutonium utilization for Japan's nuclear policy and its safety, consideration for nuclear nonproliferation, and the history of plutonium utilization, at home and abroad.

2. Measures for nuclear safeguards

Commercial reprocessing plants and MOX fuel fabrication facilities handle plutonium on a full-fledged basis. As plutonium comes to be widely used in the future, it will be important to try to come up with a new set of nuclear safeguards, which not only take into account technical developments made for enhanced efficiency and effectiveness of safeguards, but also the cost/benefit aspect of these measures.

To properly inspect the advanced type of facilities expected to be built or introduced in the future, the government must beef up, with the cooperation of proprietors of such facilities, R&D for technologies that will enable it to cope with the trend toward increased sophistication and larger size of such facilities.

In implementing nuclear safeguards, it is necessary to maintain a full cooperative relationship with the International Atomic Energy Agency (IAEA). However, at the same time, the government is requested to work on the IAEA so that applications of the safeguards will be made commensurate with the actual facilities.

3. Measures for protecting nuclear materials

Japan, a major atomic power, needs to win international trust with respect to its adherence to nuclear nonproliferation. Japan needs to sign and ratify the nuclear materials protection treaty, which should be followed by necessary domestic measures, such as implementation of related laws.

As for transportation of plutonium from abroad, international consensus is growing that an airlift is desirable for the reasons that the transportation time can be drastically shortened and nuclear material can be protected more effectively.

In order to facilitate smooth shipments back to Japan of plutonium that is produced in reprocessing spent nuclear fuel (that Japan has been sending overseas), it is important to take necessary measures for airlift operations, such as establishing technical standards, development of containers, etc.

(Reprocessing of Spent MOX Fuel)

To reprocess spent MOX fuel, the following points need to be studied. They are: increased time required for melting as the amount of plutonium increases; deterioration of the solvent; an increase in the amount of neutron doses; an increase in the amount of heat generation; the problem of criticality; and increased decontamination factors for nuclides of transuranium (TRU) elements.

Technically, these problems are considered surmountable, but reprocessing spent MOX fuel needs to be technically confirmed as the pluthermal program progresses.

Utilization of Recovered Uranium; in Re-enrichment or as MOX Feedstock

Utilizing recovered uranium derived from reprocessing spent nuclear fuel is important for effective utilization of uranium resources.

1. Recovered uranium derived from domestic reprocessing

As for recovered uranium from the Tokai Reprocessing Plant (70 to 140 tons/year) and the commercial reprocessing plant scheduled to start operation in about 1995 (800 tons/year), two types of usage are considered: 1) utilization as fuel for light-water reactors by subjecting it to a re-enrichment process, a method that involves large-scale utilization and saves much of resources; and 2) utilization as feedstock for MOX fuel under the pluthermal program, a method that does not require conversion and re-enrichment and is easy to cope with at the processing facility, although small in utilization scale.

At home, large amounts of recovered uranium are expected to be produced from the latter half of the 1990's, so required measures for practical use of the uranium need to be implemented by the middle of the 1990's, including construction of related facilities.

2. Recovered uranium derived from reprocessing abroad

Similar uses include 1) utilization in light-water reactors after re-enrichment, and 2) utilization as feedstock for MOX fuel. These are considered for recovered uranium from overseas reprocessing (about 6,000 tons). However, in examining the utilization method, full consideration needs to be given to labor costs at home and abroad.

20114/6091
CSO: 4306/2593

- END -